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AND OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. *By* L. Klein, *Civil Engineer.*

Within the last few years, internal improvements, principally railroads, have made very great progress upon the continent of Europe. The example given first by Great Britain, and later, on a much larger scale, by the United States of North America, could not fail to attract the attention of other people and governments. The important influence of facilitated internal communications upon the prosperity of a country could no longer be doubted; all prejudices against their introduction were gradually vanquished, and the spirit of enterprize and speculation became awakened. We now see extensive lines of railways already completed, and others in progress, in different parts of the continent of Europe, and at no distant period we may expect to see connected *by* them all the capitals and other important cities of the numerous states and provinces, in which this large territory is divided.

Although the United States are already provided with a system of railroads, the extent of which far exceeds that of all railroads executed in all the other parts of the globe, a notice of the works undertaken and accomplished in Europe cannot be without interest to the readers of this journal, and principally to the engineer, who may find in the history of every railroad, in the description of its locality and construction, and of the difficulties overcome, something new and in-

structive. In the following notes, for which the data were carefully collected on the spot, and may be relied on as correct, it is intended to give a short description of the works of internal improvement executed, or undertaken and in progress, in different states of the continent, in the order in which they were examined.

Having during a long stay become possessed of detailed information concerning all the railroads now in operation and in progress in Austria, I am enabled to commence the present communication with a full description of the internal improvements in that empire, though my notes may not be as complete respecting the other European States.

LETTER I.

VIENNA, 1st of September, 1841.

Internal Improvements of the Austrian Empire.

Geographical notice—Navigation—Steam navigation upon the Adriatic and Mediterranean, upon the Danube—Canals in Italy and Hungary; the Vienna and Newstadt Canal—Turnpike roads—Lintz and Gmunden—Prague and Pilsen railroads—Emperor Ferdinand's northern road—Vienna and Raab railroad—First Hungarian railroad from Presburg to Tyrnau—Milan and Montza—Milan and Venice railroads—Railroads projected; Bohemian coal road, Prague and Dresden, Vienna and Trieste railroads, central railroad of Hungary, Bochnia and Lemberg railroad.—Extent of railroads completed, in progress, and projected, in Austria.

The Austrian empire occupies the central part of the European continent, and covers the one thirteenth part of its surface. In regard to area Austria ranks the third amongst the European States, being inferior only to Russia and the United Kingdoms of Sweden and Norway; in regard to population it ranks the second, as it is surpassed only by the Russian empire. Austria extends from 42° 9′ to 51° 2′ north latitude, and from 26° 14′ to 44° 45′ east longitude, (the meridian over the island of Ferro taken as the first,) or over 8° 53′ from south to north, and 18° 21′ from west to east. It is bounded by twelve different sovereign states, of which, however, some are very small. The longest boundary line is towards Turkey, viz. 1,550 miles, while the length of boundary towards all the surrounding states is 4,166 miles. To this must be added the length of sea coast on the Adriatic, which (the islands excepted,) measures 1,248 miles, making the total length of boundary, or the circumference of the empire equal to 5,414 miles. Considerable as this length of the sea coast may appear, its advantages in regard to commerce are much diminished by the peculiar situation, form, and distance from the main body of the Austrian empire.

The monarchy of Austria is composed of sixteen large provinces, inhabited by nations different in origin and language, viz: of eight kingdoms, one Archduchy, (Austria, of which the empire bears the

name,) four Duchies, one grand Principality, one Margraviate, and one Principality—county. The following table contains the area and population of the different provinces.

Name of Province.	Area in square miles.	Population in 1837.	Inhabitants to the square mile.
Archduchy of Austria, . .	15,725	2,168,694	138
Duchy of Styria, . .	9,065	935,576	103
Kingdom of Illyria, . .	11,430	1,195,874	105
Kingdom of Bohemia, . .	21,155	4,001,925	189
Margraviate of Moravia with Silesia, .	11,060	2,074,246	188
Kingdom of Galicia, . .	35,510	4,518,360	127
Kingdom of Hungary and vicinal provinces,	92,990	11,138,942	120
Grand Principality of Transylvania,	24,705	2,170,392	88
Military boundary districts, . .	13,550	995,861	73
Kingdom of Lombardy, Venice, .	18,505	4,534,197	245
Kingdom of Dalmatia, . .	5,210	373,479	72
Principality, county of Tyrol. .	11,475	814,892	71
	270,360	34,922,438	129

This population did not include the army; with the latter it was 35,398,438. At present (1841,) the population of the whole Austrian monarchy is computed at 36,500,000 souls, equal to 135 per square mile. Only a part of the Austrian empire belongs to Germany; the area of the Austrian German provinces is 79,880 square miles, and their population, 11,613,280. The standing army of Austria consists in 324,000 soldiers.

By the Adriatic the Austrian empire is brought in contact with the sea, and in direct communication with foreign ports. Trieste, Venice, and Fiume, are the three principal sea ports of Austria, from which an active trade is carried on, not only along the coast of the Adriatic, but also with the principal ports of Italy, France, and Spain, Greece, Asia minor, and Egypt. *Trieste*, the most important port of the three, exports principally the products of the German provinces of Austria; *Venice*, once the queen of the seas, the centre port for the Indian trade, before the passage round the Cape of Good Hope was discovered, is now of minor importance, although it has been a free port several years; it exports the products of the Italian provinces. *Fiume* commands only a small trade; it is the principal port on the Adriatic, for the Hungarian provinces, with which, however, it is connected only by very bad roads. There are at present in Austria

516 vessels for distant voyages,	with a tonnage of	105,400 tons.
1320 large coasters, "	"	48,300 "
1345 small " or rather boats,	"	10,200 "
	Total tonnage,	163,900 "

Only from three to six Austrian vessels go annually from the Aus-

trian sea ports to London; about as many to the different ports of the North Sea and the Baltic; from nine to twelve make voyages to Brazil, and from fifteen to seventeen to the United States of North America. The greatest part of the foreign trade with Austria continues to be carried on by foreign vessels.

During the latter years a great impulse was given to the trade of the Mediterranean by the introduction of steam navigation, in which Austria did not remain behind. Regular trips are now made between Trieste and Venice, Trieste and Constantinople, Trieste and Ancona, &c., as also between Constantinople and the ports of Syria and Egypt. The steam navigation company of the Austrian Lloyd at Trieste, now own eleven steamboats, and the following have been their operations in 1840.

Voyages. 1840.	Number of trips.	Passengers number.	Freight, cwt.*	Packages, pieces.	Specie and precious articles, amount.	Letters, number.	Income. Dollars.
Between Trieste and Constantinople,	24	9,661	38,359	7,206	$1,764,763	10,062	219,274
" Constant., Valo, Salonica, Alexandria, and Syria,	22	6,465	2,416	185	110,254	2,162	
" Trieste and Venice,	155	15,653	9,199	10,892	4,038,942	5,786	62,276
" Trieste and ports of Dalmatia,	20	2,569	2,047	3,168	254,452	1,555	9,488
" Trieste, Ancona, and other ports of Italy.	64	5,138	1,364	230	106,913	559	12,805
	285	38,886	53,385	21,681	6,275,324	35,087	313,843
In 1839	245	27,930	40,366	15,561	5,481,563	23,251	

* One Austrian cwt. = 100 Austrian lbs. = 123½ English lbs.

The expenditure of the company for the year 1840 has been:

For loading and unloading, port and consul duties,	$ 17,234
Salaries, board of crew, repairs, and sundry disbursements, - - - - - -	107,803
Fuel: coal and wood, - - -	85,764
Administration, - - - -	54,398
Total,	$ 265,199
Net profit, - - -	48,644
	$ 313,843

Austria is traversed by many navigable rivers, but only few of them offer great facilities for internal communication. The principal river

of the Austrian empire, the mighty Danube, has a course of more than 2,000 miles of length, of which 850 miles are in Austria; it forms the natural highway to the Black Sea and the Orient. Until it reaches the plains of Hungary the current of the Danube is very rapid, having through a great part of Austria an average speed of five to six feet per second, or about four miles per hour. The width of the river is unequal; near Vienna, for instance, it is 18,000 feet, or 3.4 miles; at Belgrade, only 3,160 feet; at the "iron Port," 500 feet, and at Orsova, where the Danube leaves the Austrian territory, the width is 2,053 feet. The swiftness and changeableness of current, the shallowness in many places, winding course, cliffs, &c., offer great obstacles to navigation, especially up stream. Nevertheless, thousands of boats come down and up the river to Vienna, with provisions, and all kinds of agricultural and mineral products.

The importance of the introduction of steam navigation upon the Danube was felt at an early period, and as early as in 1819 attempts were made to that effect. Want of experience and of confidence, however, for a time, retarded their success; in 1830, a chartered company took the matter in their hands, and in the following year (1831,) the performances of the first boat, "Francis I," proved the practicability of steam navigation upon the Danube. In 1832 two steamboats made regular trips between Raab, Pest, and Semlin, in Hungary; in 1834 the "Argo" went the first over the rapids at the "Iron Port," and arrived safely at Galatz. Subsequently steam navigation was extended up the Danube, from Vienna to Lintz, and through Bavaria to Ratisbon.

The steam navigation company's boats now make regular passages throughout the navigable season between Lintz, Vienna, Pest, Semlin, Galatz, Varna, Constantinople, Trebisond, Salonica, and Smyrna. A passage from Vienna to Constantinople requires twelve days, and costs, in the first cabin, 62½ dollars, in the second cabin, 42½ dollars, and on deck, 28 dollars, exclusive of board.

In 1840 the company had in operation ten river boats and seven sea boats; at the same time they were building five new boats for 1841, making the total number twenty-two. The number of passengers carried by all the steamboats, in the year 1840, was 125,293; the quantity of freight, = 20,482 tons; the income from all sources has been:

From the ten river boats, - - -	$ 175,135
" seven sea boats, - - -	123,953
" discounts, &c., - - -	4,469
Total,	$ 303,557

Amount brought forward, - - -	303,557
The current expenses during the year amounted to	154,145
Leaving as net profit, - - -	$ 149,412

The capital stock of the company consists in 7,560 shares at 250 dollars, or in 1,890,000 dollars; the net profit in 1840 was therefore 7.9 per cent. on the capital invested.

How much the business done by the steamboats is on the increase, will be seen from the following numbers, showing the traffic from 1837 to 1840, inclusively:

	Year 1837	1838	1839	1840.
Passengers,	47,436	74,584	105,926	125,293
Tons of freight,	4,111	17,812	19,388	20,482

The steamboats used upon the Danube and the Black Sea, are all built on the English model; two of them, the "Sophia" and "Stephan," are of iron. The "Sophia" has two low pressure engines of sixty horses power each, and goes only three feet deep when loaded. She is used exclusively upon the upper Danube, between Vienna and Lintz, where navigation is most difficult. A trip down from Lintz to Vienna, a distance of 144 miles, is performed in nine hours, or at the rate of sixteen miles per hour, while a trip up, from Vienna to Lintz, requires not less than thirty-two to thirty-six hours, and sometimes more. The fuel used is coal, from the vicinity of Pilsen, in Bohemia, and costs, delivered at Lintz, eight dollars and ten cents per ton. Another company, chartered in the kingdoms of Bavaria and Wurtemberg, run their boats between Lintz and Ratisbon, in connection with those in Austria.

A new impulse will be given to the steam navigation of the Danube by the different railroads now in progress in the vicinity of this river, but still more by the "Maine and Danube Canal," in Bavaria, which approaches its completion. This canal, of which I shall take occasion to speak in my subsequent letters, is 108 miles in length, and connects the Danube, near Ratisbon, with the Maine at Bamberg; the latter river is to be improved for steam navigation to its mouth at Mentz, whence numerous steamboats are running upon the Rhine to Rotterdam and the German Ocean. On the completion of the canal, an uninterrupted connection by water will exist between the North Sea, or German Ocean, and the Black Sea, certainly one of the most magnificent lines of internal communications in the world.

Besides the steamboats upon the Danube and the Adriatic, there are only a few boats upon some of the minor rivers and lakes in Austria. A small boat has lately been started upon the Moldau at Prague, to run between that city and Dresden; she draws only sixteen inches water, but can, nevertheless, come up to Prague only at

high water, the Moldau being too shallow through a great part of the year. A great deal remains to be done in Austria in the improvement of rivers and the extension of navigation upon them. Steam navigation may, in fact, be regarded here as in its infancy, if compared with the high degree of perfection it has attained in the United States, where it originated.

Canals.—There are comparatively few canals in the Austrian empire, and most of them are in the kingdom of Lombardy—Venice, (Italy.) The following are the principal ones: the "Naviglio Grande," which connects the Ticino river and the Lago maggiore with Milan, length twenty-seven miles; the "Martezana" Canal connects the Adda, and thereby the Como lake, with Milan, and is twenty-six miles in length. The "Naviglio nuovo" extends from the Naviglio grande, at Milan, to the Ticino, at Pavia, whence by means of the Po river a connexion is effected with the Adriatic; length, nineteen miles. Many other canals of different lengths traverse the country, but serve, for the greatest part, only for irrigation.

In Hungary we have the "Francis Canal," which unites the Danube with the Theiss; it was executed between the years 1793 and 1802, by a company of stockholders, at a cost of 1,500,000 dollars; length, sixty-eight miles. The "Bega Canal," of seventy-five miles in length, serves to improve the navigation of the Bega.

There is only one canal in the other Austrian provinces, which serves for the transportation of goods, viz: the "Newstadt Canal," which extends from Vienna through Lower Austria to the frontier of Hungary. This canal was undertaken by a company in 1797, with the object of connecting Vienna with Trieste; afterwards it was resolved to extend it only to the coal mines near Oedenburg, in Hungary. In 1800, the government took charge of the works, and finished the canal to the frontier of Hungary, in a length of forty-five miles, in 1803. The extension to the coal mines at Oedenburg, (fourteen miles,) was not acceded to by the Hungarians.

The total ascent from Vienna to the other terminus of the line is 328 feet, the number of locks, fifty. The canal is thirty feet wide on the surface of the water, and four feet deep. The locks are eighty-seven feet in length, and built partly of cut stones, partly of bricks, the latter are now re-built with stones. The width of the locks is only eight feet. The boats used upon this canal are eighty feet long, and only six feet wide; they draw three feet water with their maximum load of twenty-five tons.

Since 1822, the canal is leased by the government; the present contractor pays an annual rent of 6,540 dollars, and has to keep the canal, boats, &c., in perfect order. The principal articles transported

upon this canal are bricks, wood, coal, and some merchandize; nearly all the freight is in coming down to Vienna, and the boats return back empty. The contractor of the canal is bound to forward all articles at a fixed tariff, from the 1st of April to the 30th of October, but generally the navigation of the canal is open during eight months in the year.

The contractor furnishes the boats, men, and horses, and charges to the owner of the goods so much per *load*, or per cwt. For a load of fire wood, (about eleven cords weighing eighteen tons,) the charge is for the whole distance, (forty-five miles,) fifteen dollars, or at the rate of 1.85 cents per ton per mile. The charge for coal is ninety-three cents per ton, (2,000 lbs.) for the whole distance, or 2.07 cents per ton per mile; for merchandize from Neustadt to Vienna, (thirty-eight miles,) one dollar and twenty cents, equal to 3.16 cents per ton per mile. Up to Neustadt the charge is only eleven dollars per load, or eighty cents per ton = 2.11 cents per ton per mile—6,000 bricks are reckoned a load.

There are carried annually, over the canal, about

10,000,000 of bricks, weighing	47,000 tons, (of 2,000 lbs.)
30,000 cords of fire wood,	55,000 "
Stone coal, - - -	2,500 "
Merchandize, - -	800 "
Total,	105,300 tons.

For a trip from Vienna to Neustadt and back, three days are required; the boat is drawn by one horse, and served by three men; the pilot, whose daily wages are nineteen cents; the bowsman, who receives eighteen cents, and the driver, who gets twenty cents per day. The boatmen furnish the horse, and receive for it fifteen cents per day, besides food. At present the number of boats used upon the canal is seventy; the number of arrivals at Vienna during the year 1840 was 6,339. The cost of a new canal boat is 200 dollars.

The contractor of the canal has not only to keep the canal, buildings, &c., in perfect repair, but also to re-build the old brick locks. There are thirty-four lock tenders on the line, each of whom receives twenty cents per day; the maintenance of the whole canal costs, annually, near 15,000 dollars.

There are many remarkable structures on the Neustadt Canal which deserve to be noticed, such as the fifty-eight stone bridges by which the communication between the two banks is entertained; the fifty locks, of which eight are within the city of Vienna, where, on a length of nearly two miles, the banks of the canal are protected by

perpendicular stone walls; the large basin at the terminus in Vienna, where the boats are unloaded; several large aqueducts, of which those near Baden and Neustadt are the most prominent, &c., &c.

Turnpike Roads.—Extensive is the system of turnpike roads, with which the Austrian empire is covered. Nearly all the provinces are traversed in many directions by well constructed and well maintained roads, built, for the greatest part, at the expense, and under the direction of the government. Leading from city to city, they connect all the different parts of the monarchy with each other, and with the adjoining countries, not impeded even by those numerous giant mountains, which seem to put an eternal barrier to all communications between the countries separated by them. We mention in the following only the principal lines. Regarding Vienna as the centre of the empire, the great commercial roads are:

1. That from Vienna to the Adriatic in several branches, passing the Semmering on an elevation of 3,920 feet, and the Loibl mountain on an elevation of 4,360 feet. Distance from Vienna to Trieste, 336 miles.

2. The road from Vienna to Lintz, the capital of Upper Austria, and from there to Bavaria in one, and to Innspruck, Verona, and Mantua, in another direction, passes over the Alps and surmounts the Brenner, at an elevation of 4,646 feet. Distance from Vienna to Mantua, 490 miles.

3. From Vienna to Prague there are two roads; distance, 188 miles. From Prague numerous turnpikes lead to different parts of Germany.

4. A turnpike leads from Vienna over Presburg, Raab, &c., to Buda and Pest, from there to Hermanstadt and the Walachia, and over Peterwaradin to Semlin and Belgrade, as also over Debretzin to Clausenburg. Distance from Vienna to Belgrade, (Turkey,) 490 miles; to Cronstadt, (Transylvania,) 627 miles.

5. The road from Vienna to Lemberg, the capital of Galicia, and from there to Brody, on the frontier of Russia. Length, 590 miles.

6. From Vienna over Oedenburg, Agram to Carlstadt, and continued to Fiume and Zara, in Dalmatia. Distance to Zara, 400 miles.

In regard to the difficulties overcome in their construction, the following deserve particularly to be mentioned, the road from Carlstadt to Fiume, constructed in 1809, which surmounts a summit of 3,120 feet in height, and is nevertheless used by the heaviest wagons; the military road over the Stilfserjoch mountain, built from 1820 to 1825, at an expense of 1,450,000 dollars; it extends from Bormia to Tyrol, where it connects with the road to Innspruck, and is the highest known pas-

sage over the Alps, as the summit of the Stilfserjoch is 9,536 feet high, and therefore elevated above the snow region.

In the same manner as the great commercial roads are connecting the metropolis of the empire with the capitals of the provinces, the provincial roads connect these latter with other less important towns, and by these lateral roads new extensive connexions are again formed. All these roads were constructed, and are maintained by the government, which expends annually, for this purpose, from two to three millions of dollars. The cost of maintenance is partly sustained from the tolls collected.

Constructed in a less expensive and durable manner, but still more extensive are those roads which are built and maintained by the communities; they form innumerable branches to the commercial and provincial roads, and extend the facilities of intercourse to the very door of the agriculturist. Most of these roads are to be found in the kingdom of Lombardy—Venice; while in Hungary, on the contrary, very little has been done yet in this respect. According to statistical data the following is the extent of roads in the different provinces of Austria, with the exception of Hungary and the adjoining provinces.

Name of province.	Turnpike roads built and maintained by government.	Other roads.	Total length of roads.
	Miles.	Miles.	Miles.
Lombardy—Venice,	2,580	18,390	20,970
Illyria, . .	870	2,300	3,170
Bohemia, .	2,000	5,220	7,220
Austria, . .	1,175	3,920	5,095
Tyrol, .	790	1,460	2,250
Styria, . .	475	2,155	2,630
Monravia and Silesia,	565	2,800	3,365
Galicia,	1,735	520	2,255
Dalmatia.	170	390	560
	10,360	37,165	47,515

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Force of the Wind and Sea, observed at the Delaware Breakwater in 1830 *and* 1831, *with some suggestions concerning the transverse sections of Breakwaters. By* Ellwood Morris, *Civil Engineer.*

That the force of the sea and wind often operates with tremendous energy against objects which resist their action, is a fact well known; to measure this force with precision is from the nature of things impossible, and hence it is only by a close attention to the observed

effect produced by the waves of storms, upon opposing objects, that the engineer is enabled to form a proper idea of the energies of an agitated sea, when roused by gales to the assault of works raised for the protection of harbours.

To form a well sheltered harbour upon a site fairly exposed to the ocean, is one of the most difficult problems which can be proposed for solution by the engineer, for such is the difficulty of forming a stable barrier against the sea, that notwithstanding all that has been done in erecting sea-works under the direction of the ablest minds, we can at this day scarcely, if at all, point to an artificial harbour in a dangerous roadstead, which has realized the expectations of its projectors.

To appreciate, properly, the active forces which we are to countervail, is the first step in framing plans for sea-works; and to add another to the number of observed facts bearing upon this subject, is the object of the present article.

In the years 1830 and 1831, the writer (then assistant engineer at the Delaware Breakwater,) had occasion to notice particularly, the severity of the action of storms upon such portions of that work as were then elevated above low water mark; the results of these observations we will now detail, merely premising first such brief account of the work itself as seems necessary to a full understanding of the subject.

The Delaware Breakwater was located and begun in 1829; it will, when finished,* consist of two detached dikes of rock, *the Breakwater proper*, a work of 1200 yards in extent, running in a line tangent to the seaward extremity of Cape Henlopen, and commencing at 500 yards distant therefrom; the *ice-breaker*, a work 500 yards long, lying obliquely across the prolongation of the line of the Breakwater, and distant from its western end 350 yards, at the nearest point; the Breakwater lies nearly in the original course of the ebb tide, trending E. S. E. and W. N. W., and will cover the harbour from the northern and eastern winds; whilst the ice-breaker (mainly designed to shelter the anchorage from ice drifting on the ebb,) bears E. by N. and W. by S., and will, at the same time, protect the interior from the winds of the north-west quarter; the contained angle between the horizontal projections of the two works being thirteen of the southern points of the compass, or 146¼°.

This artificial harbour is located in Cape Henlopen road, just within the pitch of the Cape, and its site is fully exposed to the sea-winds which blow directly in from the Atlantic ocean, over the whole arc

* If it be completed upon the plan projected by Com. Rodgers, Gen. Bernard, and W. Strickland, Esq., Commissioners; and approved by President J. Q. Adams, on the 27th of February, 1829.

comprised between E. S. E. and N. E. by N. around by the East, measuring seven compass points, or $78\frac{3}{4}^\circ$; whilst on the other hand, it is also exposed to winds sweeping an extent, for the most part, of deep water, upon lines of twenty miles long in the Delaware Bay, and including, in their field of action, the whole arc contained between the N. E. by N. and W. S. W., around by the West, being thirteen points, or $146\frac{1}{4}^\circ$; from the W. S. W. around by the South to E. S. E., an arc of twelve points, or 135°; the roadstead is completely landlocked by the shoals of Broadkill, and the main strand in front of the town of Lewes, Sussex county, Delaware.

From the above statement it is evident that the roadstead under Cape Henlopen is wholly exposed to the winds of the north-east quarter, the severest that blow upon the American coast, and which fling upon the strand within the Cape those tremendous billows which are raised by the sweep of the north-east gales over a free range of ocean; whoever has witnessed the fury of these storms upon our sea-coast, will, from these remarks, appreciate the violence of the seas which sweep that perilous road, wherein the writer has himself seen fourteen sail of vessels stranded at the same time, and with the loss of several valuable lives.

The average rise and fall of the tide in Cape Henlopen road is five feet, the highest spring tides, in moderate weather, seven feet, whilst the highest storm tides have been known to attain an altitude of ten feet and more above the plane of low water.

Previous to the month of August 1830, the ice-breaker, at its eastern or seaward end, had been brought up to the shape sectionally indicated by Figure 1; in the centre of the top a stone pier was erected, its shape, a frustrum of a pyramid, $14\frac{1}{2}$ feet long, two and a half feet square in the middle, and weighing seven tons; this was firmly secured on every side by split stone stays of one and a half tons weight, well laid and packed, and the whole of the work then appearing above the water had a flat slope seaward, and was as firmly and compactly formed as was possible with large and rough stone laid without mortar; in the centre of the top of the stone pier (which was elevated ten feet above high water,) a light flag-staff, some twenty feet long, was fixed in a vertical socket, upon a wrought iron pintle fourteen inches long and one and a half inches in diameter.

Figure 1 exhibits the appearance of the work as formed previous to a severe north-east gale which occurred in August 1830.

Figure 2 exhibits the appearance of the work immediately after the gale referred to.

Both of the figures are sketched from measurements made by the writer at the time, and in both O, is the line of common high water, and P, the low water plane.

During this gale a number of heavy stones were swept from the top of the work, and the chief part of the split stone stays, weighing one and a half tons each, were torn from their beds, and transported forty feet to the westward; the stone pier was canted to an angle of 30° with the vertical, and would undoubtedly have been driven over the harbour slope, and lost, if the gale had continued longer; the flag-staff, by the force of the wind and the crests of the billows which swept the work, was forced into the position shown in figure 2, and the wrought iron pintle supporting it, of one and a half inches diameter, *was bent to a right angle!*

The stone pier was soon after replaced, the work rebuilt, and in October, 1830, when the operations of that season terminated, it had been brought up to the shape indicated by the strong or upper lines of Figure 3, the greatest care having been taken to form the whole top surface into a heavy pavement, sloped seaward with a gentle declination, compactly laid, and well wedged with spalls of stone driven by hammers into every crevice; the lower, or broken line of Figure 3, shows the outline of the work as actually found in April, 1831; the storms of the winter of 1830 having denuded the whole space between the two lines, and swept off down the harbour slope, the stone pier of seven tons weight, its split stone stays averaging one and a half tons each, and more than 200 tons of other stone,* many of which exceeded a ton in weight, few being under a quarter of a ton, and all having been previously wedged and compacted together, as has been described.

Thus was the ice-breaker dismantled by the furious winter sea of 1830, whilst the Breakwater proper also suffered severely during the same time; a stone pier of the same dimensions and weight as that we have already described, was landed upon the top of the Breakwater late in the season of 1830, but from want of time was not

* Similar effects have often been produced by storms upon other Breakwaters; thus we find it stated in De La Beche's Geological Manual, that "during the severe gales of November 1824, and again at the commencement of 1829, blocks of lime-stone and granite, from two to five tons weight, were washed about on the Breakwater at Plymouth, *like pebbles;* about 300 tons, in blocks of these dimensions, being carried a distance of two hundred feet, and even up the inclined plane of the Breakwater."

"These blocks were thrown over on the other side, where they remained after the gale scattered in various directions. A block of lime-stone, weighing seven tons, was washed round the western extremity of the Breakwater, and carried 150 feet."

As the experience of the action of the sea upon the Breakwater at Cherbourg was of the same character, it seems unnecessary to quote it; the tendency of the whole is to show that the present mode of relying upon heavy pavements, for the security of the summits of Breakwaters, does not answer the purpose, whilst it seems to inculcate the necessity of forming the coping of such works of a mass of stone of great depth, *so bonded as to gravitate as one body;* as is suggested in a subsequent part of this paper.

erected, and was left laying with its top surface level with high water mark; during a gale of wind in the early part of December of that year, it was moved, broadside foremost, about eighteen feet, and finally in a storm upon the 15th of January, 1831, together with many other heavy stones, it was precipitated down the harbour slope and lost; this work, when closely inspected by the writer, in April 1831, showed that a great many of the surface stones had been arranged by the action of the sea, with their longer axes tending towards the point of the strongest wind, or to the north-east, with their ends often lapping over each other, in form slightly resembling the shingling of a house, and after attaining this position they appeared generally to have maintained it, though it was evident enough that many others had been swept away.

The storms which produced the effects we have recited, though severe, were not remarkably so, and have, without doubt, often been surpassed in violence, by those tremendous easterly storms, which, at intervals of a few years, devastate our coast.

The effects which we have recorded were produced by adequate causes, of which they are in some sort the measure; and it may perhaps be neither uninteresting nor unimportant, in a professional point of view, to enter briefly into a discussion of the mode of action of the sea waves against opposing obstacles, and the proper section which it appears to prescribe for the summits of Breakwaters.

In this connexion the first thing we have to consider is the probable maximum altitude of the waves of the sea. Arnott, in his "Elements of Physics," in referring to the billows created in the ocean at a distance from the land, observes that "no wave rises more than ten feet above the ordinary sea level, which, with the ten feet that its surface afterwards descends below this, gives twenty feet for the whole height, from the bottom of any water valley to an adjoining summit."

This estimate is probably correct, though other writers have asserted that the altitude of the highest waves from the trough to the crest, reaches thirty, or even according to some, fifty feet;* but when we reflect that all the circumstances of a storm at sea tend to inflate our ideas of the magnitude of what takes place, such statements must be received with caution.

Where waves approach a sloping coast, they are borne up by the submerged land, they mount higher, as upon an inclined plane, and finally combing over at the crest, discharge themselves in breakers upon the beach.

* See the number of this Journal for August, 1836. Since writing the above the writer has been informed that the late France Exploring Expedition determined this question very accurately in the midst of the Pacific ocean, and fixed the maximum height of waves at 22 feet.

The justly celebrated Smeaton, in his account of the building of the Eddystone Lighthouse, informs us, that during, and immediately after, a severe storm, the billows of the ocean, borne up by the inclined strata of the rocks of the Eddystone, mount to such a surprising altitude as actually to envelope the lantern, at a height of more than eighty feet above the usual surface of the sea, and comb over it, in form similar to the prodigious jet of water which is projected ninety feet into the air, from the great Geyser in Iceland.

Returning from this digression upon the phenomena of waves, we will observe that in the case of Breakwaters, rising abruptly as they do from the bottom of the sea, it seems probable that the augmentation of altitude which waves receive in running upon an inclined coast, is not produced by them, or if at all, in but a slight degree.

The stones forming the summits of Breakwaters, when assailed by the waves of the sea, are solicited by two forces, one acting vertically upward, with the force due to the hydrostatic pressure of a column of water, equal in altitude to the maximum wave which assails the work, and which force we can estimate; the other is the horizontal force due to the progressive motion of the billows, the extent of which we have no means of determining.

We may make a practical application of these views as follows; the heaviest stone used in the construction of the Delaware Breakwater, consisting of Trap rock, from the Palisadès on the Hudson river, weighed 184 lbs. to the cubic foot; whilst the lightest, being the Hornblende rock, from Quarryville, in the northern part of the State of Delaware, weighed but 165 lbs. to the cubic foot;* the average weight of the materials being 175 lbs. per cubic foot, or two and seventh-tenth times heavier than sea water.

Let us assume, according to Arnott, the maximum altitude of waves to be twenty feet, then if we take the case of the Delaware Breakwater, where the storm tides rise ten feet, let *a*, in the annexed sketch, Figure 4, be the top level of the storm tide, *b*, the plane of low water, *c*, the dry rubble foundation of the work thrown promiscuously from vessels into the water, *d*, a mass of stone lying upon the rubble foundation, with its base coincident with the plane of low water, and

* The Hornblende rock referred to, as weighing 165 lbs. to the cubic foot, was the Greenstone from Jaque's quarry. A specimen of Gray Gneiss, from one of Leiper and Crosby's quarries, was found at the same time to weigh 168 lbs. to the cubic foot; and some Black Gneiss from Hill's quarry, on Crum Creek, weighed 177 lbs. per cubic foot. All the specimens of the above rocks, of which the specific gravity was tried by the writer, were broken off from masses of stone delivered at the Delaware Breakwater, in the construction of which all these varieties were then used. The specific gravities of some specimens of similar rocks, from the same quarries, were subsequently found by a committee of the Franklin Institute, to be somewhat greater than is above stated.

e, a wave of twenty feet high, advancing from sea at high water in the direction of the arrow, the crest rising ten feet above the high water plane, and the trough falling ten feet below it; then it is manifest that though whilst the wave is upheaving near the margin of the work, it may not act very powerfully upon substances in front of its base, yet the moment it begins to subside, if it happens to be in the position indicated in the sketch, with its fore foot inserted under the mass of stone, *d*, it will exert upon that mass the upward hydrostatic pressure due to a head of twenty feet, and in an instant after the horizontal force due to the progressive motion of the wave; and thus, as it were, *by successive pulsations*, the waves possess the power of advancing forward immense masses of rock.

Now the upward hydrostatic pressure of a column of sea water twenty feet high, would equal the gravity of a mass of stone weighing 175 lbs. to the foot, if the vertical thickness of the latter were $= \frac{20}{2\frac{7}{10}}$, or near seven and a half feet;* *consequently, if the depth or thickness of the mass of stone were less than seven and a half feet, it would be advanced a little to leeward by each successive wave; but if it were of greater vertical thickness it would stand fast; and resist the hydrostatic and progressive action of waves, not surpassing twenty feet in height.*

Breakwaters are, however, occasionally subject to augmented vio-

* Corroborative of this calculation, we find it stated in Lyell's Principles of Geology, that "on the Isle of Stenness, in the winter of 1802, a tabular mass of stone, eight and one-sixth feet by seven feet, by five and one-sixth feet in depth, was dislodged from its bed, (by the sea,) and removed to a distance of from eighty to ninety feet."

This quotation shows clearly enough that a depth of *more than five and one-sixth feet of stone* is necessary to withstand the action of waves.

A similar circumstance is stated in the public prints to have occurred in a severe storm recently, upon the coast of Massachusetts, near the Boon Island Lighthouse, where "a huge rock twenty-three feet long, sixteen feet wide, and six feet thick," which weighed probably 170 tons, was moved by the waves a considerable distance *up an inclined surface;* evincing there *that a vertical depth of six feet of solid stone* did not possess sufficient stability to resist the force of the sea.

How much more accurately than the moderns, the ancients appreciated the powerful action of waves against sea works, may be inferred by the following paragraph, quoted from Josephus, by Godwin, in the Trans. Instit. Brit. Archts., 1835–6.

"In order to form a port between Dora and Joppa, Herod, in the fifteenth year of his reign, ordered mighty stones to be cast into the sea at twenty fathoms water, to prepare a foundation; the greater number of them fifty feet in length, nine feet deep, and ten feet wide, and some were even larger than these."

Stone of these predigious dimensions would be very likely to maintain their places in ordinary storms; and their magnitude is in striking contrast to the comparatively small materials used in modern Breakwaters, which, as a necessary consequence, *require incessant repairs.*

lence, from the assault of waves during storms, *owing to the partial removal of atmospheric pressure;* a fact which has recently been observed by James Walker, Esq., F. R. S. &c., President of the British Institution of Civil Engineers, and which was mentioned by him at a recent meeting of that Institute, (as reported in the Civil Engineer and Architects' Journal for September 1841,) in the following words: "At the Plymouth Breakwater, during the great storm in the month of February 1838, several of the largest granite blocks, weighing from three to eight tons each, composing the surface or pavement of the Breakwater, which, although squared and dovetailed into the structure, and embedded in excellent cement to the extent of their whole depth, and thus forming a solid mass, were torn from their positions, and projected over the Breakwater into the Sound."

"Mr. Walker attributed this to the hydrostatic pressure exerted beneath the stones, at the moment when the atmospheric pressure above had been disturbed by the masses of water suddenly and rapidly thrown upon the surface of the Breakwater; blocks of stone were thus often carried to a great distance, not so much by the waves lifting them as by the vacuum created above by the motion of the water, which exerted at the same time its full pressure from below."

And as additional evidence that the formation of a partial vacuum is sometimes a consequence of the envelopment of sea works by high waves, Mr. Walker further stated, "that during a storm in the year 1840, the sea door of the Eddystone Light-house was forced outwards, and its strong iron bolts and hinges broken by the atmospheric pressure from within. In this instance he conceived that the sweep of the vast body of water in motion round the light-house had created a partial and momentary, though effectual vacuum, and thus enabled the atmospheric pressure within the building to act upon the only yielding part of the structure."

As both the above remarkable instances came professionally under the notice of Mr. Walker, we are bound to place the utmost reliance upon the inferences derivable from his statements; and they indicate conclusively that no lateral connexion by dovetails, or otherwise, will compensate for a want of depth of solid stone; but that we must rely for stability in the coping of sea works, chiefly upon the weight of a large mass of materials, *so connected as to gravitate as one body;* we must oppose pressure by weight, and counteract by gravity the action of forces resulting from a disturbed equilibrium.

The pressure of the atmosphere is about the same per superficial foot as would be produced by the gravity of 11½ feet depth of stone weighing 175 lbs. per cubic foot; therefore, if Breakwaters

were liable to be assailed by waves but twenty feet high,* at the same time that the atmospheric pressure *was wholly removed*, their summits would require coping with a depth of stone wrought into a solid mass, equal to $11\frac{1}{2} + 7\frac{1}{2}$, or 19 feet, measured vertically.

In the nature of things, however, we cannot suppose that *the whole pressure* of the atmosphere would ever be removed from any point of the summit of a Breakwater whilst a wave of the maximum height was acting beneath; and though this is very much a matter of conjecture, we may probably infer that under no circumstances would more than two-thirds of the atmospheric pressure be removed from any point; this would be countervailed by a depth of eight feet of stone weighing 175 lbs. to the cubic foot, and as we have shown that a depth of near seven and a half feet is necessary to withstand the hydrostatic pressure of a twenty feet wave, we may finally infer that *the summits of Breakwaters should never consist of less than fifteen feet average depth of stone firmly bound into a solid mass, by clamps, dowels, and cement, so as to gravitate as one body.*†

The fact that continual repairs are rendered necessary, by the blowing up and sweeping away of portions of the pavements of existing

* The maximum height attained by the waves of the most violent storms, at the sites of Breakwaters, is such an important element in forming the plan of the work, that it ought always to be ascertained experimentally, (which would not be difficult,) by attaching a machine upon the principle of a self-registering tide gauge, to a pile well driven at the site, and properly braced against the sea.

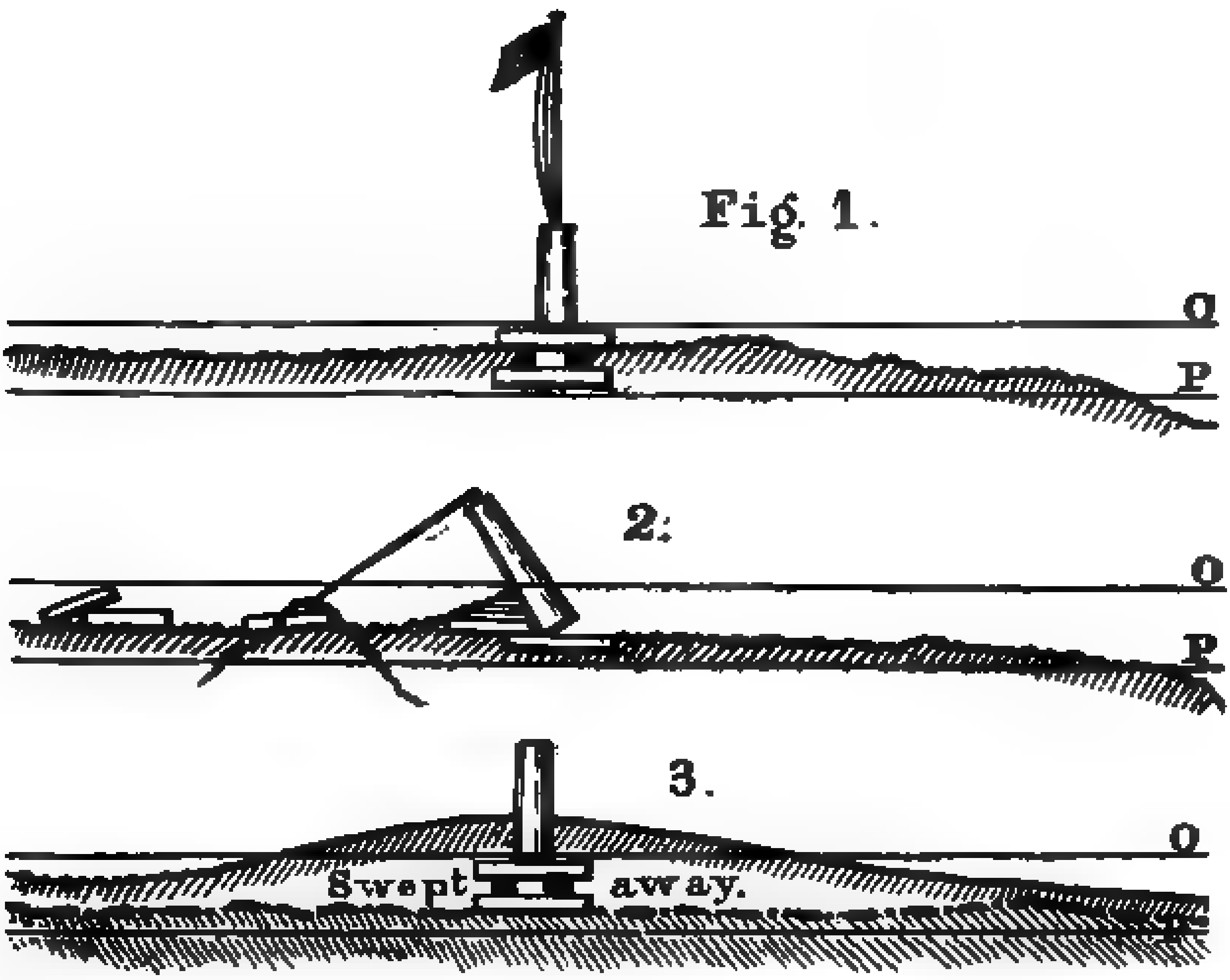
† This principle of constructing sea works, was adopted in Rudyerd's Light-house, built upon the Eddystone, in 1709, and which, after successfully withstanding the storms of half a century, was destroyed by fire in 1759; regarding it, Smeaton states that Rudyerd "judiciously laid hold of the great principle of engineering," that "*weight is the most naturally and effectually resisted by weight*," and accordingly formed his light-house, near its foundation, *solid*, and mainly of stone, for such a height as he conceived would enable the gravity of the mass to resist the upward hydrostatic pressure of the waves, in case the water insinuated itself beneath the building.

This idea was not lost upon the able and sagacious Smeaton, who, in erecting the famous stone light-house which succeeded Rudyerd's, built the first thirty feet high from the foundation, *solid*, and so proportioned the walls and lantern above the fundamental solid that if their mass were reduced to a cylindrical shape it would add another solid column of about twenty feet in height; so that in opposing the action of the sea, the Eddystone Light-house is equivalent to a solid column of stone fifty feet in altitude.

Now from the above reasoning, $50 \times 2\ 7\text{-}10$, or 135 feet, is the altitude of the wave, whose upward hydrostatic action this building is, by its gravity alone, competent to resist; and as the atmospheric pressure is never removed from its summit, whilst the utmost altitude of the jet of water which is sometimes thrown over the lantern is short of 100 feet, its superabundant stability must be manifest.

The courses of this celebrated construction being dovetailed and joggled together, so as to prevent movement laterally; as long as its materials are proof against decay, the immutable laws of gravitation will retain it in position, and enable it to defy, as it has for eighty-two years defied, the utmost force of the Atlantic storms; unless, indeed, it should be assaulted by waves more than 135 feet high, which is not within the range of probability.

Breakwaters, during violent storms, strongly sustains the views taken in this paper, and shows but too clearly, that the mass of stone usually combined upon their summits, is deficient in the requisite stability.



The form in which the stone ought to be laid and connected together, should (the writer believes,) be that of a semi-cylinder, the axis lengthwise of the work, and the base laid upon such an inclination seaward as may counteract sliding, and prevent the possibility of its overturning upon the harbour angle, for we know that on a level plane, one half the amount of force will overturn a body which is necessary to lift it.

In the case, then, of a Breakwater similarly situated to that of the Delaware, stone weighing 175 lbs. to the cubic foot, and exposed to the assault of waves not exceeding twenty feet high, it would seem that the section shown in the following Figure 5, would be a proper one.

c

a, the high water line of spring tides, above which storm tides rise three feet or more; *b*, the plane of low water; *c*, semi-cylindrical mass of stone at least thirty two feet in diameter, thoroughly cemented and bonded together; *d*, fore shore securing the angle of the sea slope, to be mainly formed of cubical blocks of rough stone, weighing at least ten tons each; *e*, the general foundation raised to the low water plane by rubble stone thrown promiscuously into the water from the decks of vessels;* *f*, cemented foundation prepared for the semi-cylinder, and having a top slope seaward of about six feet base to one foot rise.

The advantage of a semi-cylindrical solid (which must average fifteen feet deep vertically) is that if in the construction it is properly bonded on the diameter, with thorough courses of dressed stone, whilst the blocks which form the curved surface are cut like *arch stone*, no one stone could be by any means extracted from its place if properly doweled laterally, and the whole would resist motion *by its gravity as one solid mass;* the interior backing or hearting of the semi-cylinder would be composed of rubble stone well set in cement mortar, and grouted full in low courses, divided into sections for the purpose.

It is a general idea that the forces acting against a Breakwater are augmented by a great rise and fall of the tide, but from the above reasoning it would appear that such a rise and fall as will allow a wave of the maximum height of twenty feet to exert its greatest energy; or a difference of ten feet between the top water of storm tides and the low water plane, (as exists at the Delaware Breakwater,) *will enable such waves to act with as much power upon sea works as any other variation of tidal surface*, and hence a greater rise and

* Experience at the Delaware Breakwater proved that by this process alone a rough stone work could be brought up with precision to a plane of two feet under the high water of neap tide.

fall than ten feet will not increase, whilst a less one would certainly diminish, the effects of the assailing waves.

The section of the Delaware Breakwater, as planned by the Commissioners appointed by the President of the United States, in 1829, under the act of Congress of May 24th, 1824, was trapezoidal in its general outline, the sea slope having a base of 105¾ feet to a height of thirty-nine feet, and being profiled after the curvilinear figure to which the waves of storms had reduced that of the Breakwater at Cherbourg; the top was fixed at twenty-two feet,* and the internal or harbour slope at one to one, or thirty-nine feet base, the entire base being 166¾ feet to a height of thirty-nine feet; the base of the section which we have proposed as sufficient for a similar work, is 160 feet, and the transverse area would be nearly the same as that of the Breakwater in the Bay of Delaware.

Philadelphia, Nov. 1st, 1841.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cast Iron Rail for the Hiwassee Railroad.† *Designed by* John C. Trautwine, *Civil Engineer.*

To the Committee on Publication.

Gentlemen.—I send you a drawing of a rail which I conceive to possess some advantages over those hitherto employed, and which I shall introduce upon the railroad now under my charge. The great distance of our line from the nearest available shipping port, would have increased the cost of European iron to so serious an extent that our Board of Directors resolved to manufacture their own rails. About $110 per ton would have been the cost of English rolled rails, delivered along the line; nor could we obtain any lower bids from our Tennessee iron masters, although advertisements were published for some time, calling upon them for proposals. The principal cause of this was the limited scale of their establishments, which would not admit of their embarking in an enterprize so much more extensive than any of them had been accustomed to.

In furtherance of the object of the Board, the President and myself were deputized to visit the East, with instructions to procure such information, machinery, and workmen, as were essential for the manufacture of our iron, in every department, from the ore to the finished rail.

* With the design of increasing it to thirty feet if subsequently found necessary.

† This road runs from Knoxville, in East Tennessee, to the dividing line between the States of Tennessee and Georgia, where it unites with other lines now under construction, extending to Charleston and Savannah. Its length is 94½ miles.

The result of our investigations was a firm conviction on the part of both, that we could, by the use of coke, make our rails at about $ 60 per ton, or about one-half the price at which we could import them from England.

Having accomplished the object of our mission, the preliminary preparations for erecting the smelting furnaces, and rolling mill, were entered upon; but before much progress had been made in them, I had become so fully convinced of the efficiency and economy of *cast-iron for rails*, that I submitted to the Board a paper, recommending the abandonment of the rolling mill, and the substitution of a cast rail, of the accompanying design, for the rolled bridge rail, which I had first advocated.

My advice was adopted, and a corresponding change made in our plan of operations. Among other things, we decided to use *charcoal* instead of *coke,** as producing iron of a superior quality for a *cast* rail.

In designing this rail, I availed myself of the results which have, of late years, been elicited from experiments made in both England and the United States, with a view of determining the strongest form of a cast iron beam.

The surprizing discrepancy between these experiments, and the previously received theories, first awakened in me the hope that an effective cast rail might be made of a much less weight than was generally supposed; and although the nature of a rail, (which requires some modifications involving a departure from the strongest form of beam attainable by a given weight of metal,) does not admit of an application of the newly discovered properties of cast iron to their fullest extent, still I suspect I have made a nearer approximation of them than has hitherto been attained. The cases of a rail, and of a girder, are to a great degree analogous; and I have endeavoured to reconcile them so far as their respective functions admitted.

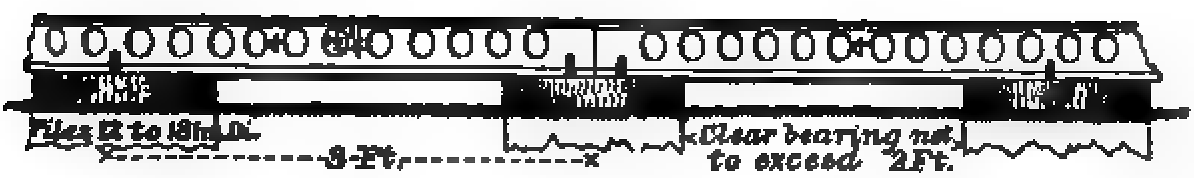
The first point clearly demonstrated, in my opinion, is the necessity of removing as much metal as possible from the vicinity of the neutral axis, and transferring it to the bottom rib, or base of the rail. With this view I introduced the openings in the sides of my rail, (see drawing;) and rejecting the use of the chair, *which contributes*

* This change was made at the suggestion of Mr. William Firmstone, now of Pottsville Pennsylvania, who visited Tennessee for the purpose of designing our furnaces. I introduce his name that I may have an opportunity of expressing the entire satisfaction with which his skill, his readiness to impart information, and his urbane demeanour, impressed the Board of Directors and myself. I trust that his valuable services may meet with constant requisition.

nothing to its strength, I employed both in forming a continuous bottom rib, extending entirely across the rail.

Transverse section. Half size.

Side View.



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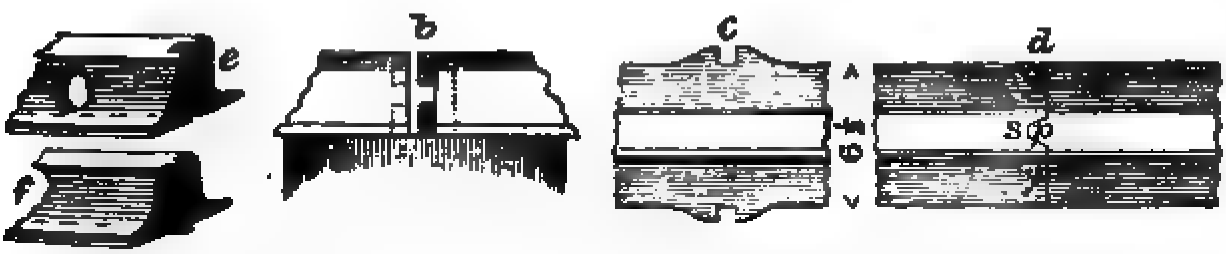


By this arrangement of the metal, I doubt not that a *much stiffer* rail can be made with a given weight of cast iron than of rolled, for the latter does not admit of this modification. Indeed the facility with which the most advantageous form, as deduced from theory, can be imparted to cast iron, constitutes an essential argument in deciding between the comparative merits of it and rolled iron.

Now a very important question is to be considered, viz: can we make a cast iron rail of sufficient strength to resist the accidental percussions to which it must necessarily be subjected occasionally, without the use of so much metal as to raise its cost to that of rolled iron. The answer to this question, of course involves the comparative cost of rolled and cast iron; and in endeavouring to solve it, I shall assume prices, which experience has shown may be safely depended on. Of course, I allude to prices in the United States, and also to the *manufacturing prices,* exclusive of the profits of the iron master; for I am willing to hope that other railroad companies besides ours, may find

it to their interest to make their own rails. Where ore and fuel are easily attainable, there can, in my opinion, be no doubt as to the expediency of their so doing.

For the sake of expediting our inquiry, we will assume that my rail is sufficiently strong for railroad purposes, (as I hope to show it is,) and base our calculations upon it. Now, setting down the price of rolled iron at $ 60 per ton, and that of cast iron at $ 30; and supposing the weight of an efficient rolled rail to be seventy-two* tons per mile of a single track road, and that of the cast rail 110 tons per mile; we have the cost of the former equal to $ 4,320, or adding the weight of chairs, (say ten tons at $ 30,) a total of $ 4,620; while that of the latter is but $ 3,300; leaving a balance of $ 1,320 in favour of the cast rail, on each mile of single track road. To this difference may fairly be added about $ 200 per mile for the reduced number of spikes gained by rejecting the chairs, so that the balance in favour of the cast rail may be set down at $ 1,500 per mile of single track. Any saving that might accrue in laying down the rails, from dispensing with the labour of fixing the chairs, would be counterbalanced by the increased expense of handling the great weight of the cast rail, and of course should not be taken into consideration. The question of *cost* being therefore settled in favour of cast iron, it remains to inquire whether our assumption of the efficiency of my rail was well founded. And this consideration is, I believe, generally admitted to resolve itself into the single question of its resistance to the *accidental shocks* which occur on every railroad.

The answer to this inquiry, from the limited data with which we are provided for its solution, must necessarily be an empirical one. From all the experiments I have seen recorded, I do not doubt that this rail will bear, with *perfect safety*, a *quiescent* load of at least *ten tons to a wheel;* and that one of *double* that weight would be required to *break it.* Now, it will, in all probability, never be found expedient, in practice, to place more than three tons on a wheel, not even on the driving wheel of a locomotive, for there are considerations which, in my opinion, render it preferable to increase the number of driving wheels, instead of placing more than three tons on any single one. Thus we see that the rail will bear, with *perfect safety* a *quiescent load* more than three times as great as it will be likely ever to be subjected to, and more than six times as great as would be required to break it. The test load which I intend to apply to my rails, before laying them on the road, will be fifteen tons to a wheel; and should it happen, (as I cannot anticipate,) that that load

* This is the weight of the rolled bridge rail, which I had adopted before the substitution of the cast rail.

is too great, I shall, instead of diminishing it, increase the strength of the rail.

But it is the *percussive*, and not the *quiescent* force, against which we must guard. There can be no doubt, I presume, in the mind of any Engineer, that if the rail were required to bear only the quiescent load referred to, the case would admit of no dispute.

To attempt, (with the limited data we now possess,) to *calculate* what this force would be, in any particular instance, might serve as an amusement for abstract mathematicians, but would be attended with results quite as deceptive as their researches into the equilibrium of arches, and many other subjects, in which, for want of *experimental* data, most erroneous assumptions were employed as the basis of their investigations. I hesitate not to say, that with our present data, the query is not susceptible of solution.

"Give me a *fact*, and I'll make you a *theory*," wisely said a certain professor; and in pursuance of his idea, we shall merely present to the reader the following fact. It may be objected that this is a very unsatisfactory mode of determining the point in question. This I admit; and my apology for submitting it, is simply that I know of none more satisfactory.

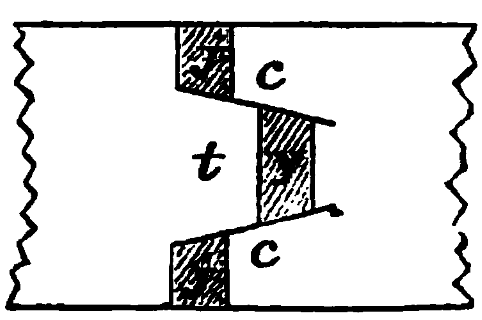
Mr. Strickland, in his reports, (see Strickland's Reports, page 29,) remarks that the best cast rail he saw in England was the elliptical rail used on the Sunderland and Hetton road; on which a traffic of 1,000 tons per day was carried. Now, in comparing these rails with mine, *three very essential* points of difference will be perceived, all favouring the latter, viz: 1st. Mine contains fifty per cent. more metal than the English rail; the latter weighing, without its chairs, seventy-two tons per mile, single track, and mine 110 tons.* 2nd. The form of mine is much better adapted to securing the maximum of strength with the minimum of material. 3rd. The clear bearing of my rail is but *one-half* that of the English. Now I conceive, that supposing the two rails, with their respective weights, to be of the same shape, and to differ in no other respect, mine should even then bear one-half more than the other, making their comparative strengths as one to one and a half. But experiment has shown, that with the proportionate weight of the two rails, the difference of *form* gives a comparative strength of *at least* one to two in favour of mine. This brings up the former proportion to, as one to three. But again the same experiments have shown that the resistances of the rails will be inversely about as their length; this fact still further augments the proportionate difference to, as one to six. In other words, I conceive my rail to be six times as strong as the Hetton rail, pronounced by

*Of 2240 lbs.

Mr. Strickland to be the best *cast* rail he saw in England. It is true, that at the time he wrote his reports, railroads were in their infancy, locomotives were lighter, and their speed less than at the present day, but still no subsequent experience has indicated a necessity for making the cast rail more than six times as strong as those in use at that time.

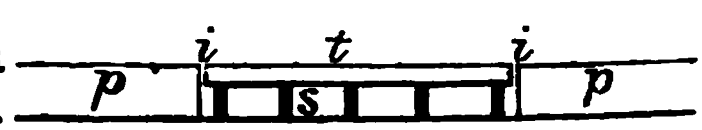
In order to guard as far as practicable, against unusual shocks, I have adopted a form of joint for my rail, which, in connexion with the use of piles firmly driven, will, I suspect, effectually prevent any displacement, and secure a perfectly smooth and unyielding surface for the cars to travel over. This joint is exhibited in figs. *b*, *d*, *e*, and it will be seen, on examination, that it secures the ends of any two rails from either *horizontal* or *vertical* displacement, with reference to each other.

I will here mention an advantage of the greatest importance, attending the use of a tongue, which, for what I am aware to the contrary, may be generally known, but which I do not recollect ever to have seen recorded, viz., *that it prevents the wheels from falling into the joints between the rails*, no matter how open they may be. Thus the tongue *t* prevents the wheels from settling into the parts *i i*, of the joint, and the sides *c c*, of the mortise, prevent them from settling into the part *y*; so that if we can only prevent *vertical* displacement at the joinings of the rails, the opening of the joints by contraction and expansion becomes a matter of no importance.



After my rails are spiked down I intend to dress off the joints perfectly by filing, and I expect them afterwards to retain their adjustment. I shall, moreover, append, as a permanent attachment, a strong guard in front of each locomotive, which, by descending to within an inch of the rail, will throw from the track any casual obstruction that would give rise to a dangerous elevation of the wheels.

I have spoken of my intention to test all my rails before permitting them to be laid on the road. The apparatus which I shall use for this purpose is very simple, consisting merely of a loaded car, running on a few feet of permanent and very strong rails, *p p*, which are laid with a sufficient interval, *i i*, to allow of the introduction of the rail to be tested, *t*. The car loaded with fifteen tons to a wheel, is pushed from one permanent rail to the other, passing over *t*, in its transit. By means of this apparatus, I shall be able to ascertain whether my rail requires any modifications before final adoption. I hope too, to be able, before long, to institute a set of experiments on cast iron beams, more full than any hitherto tried.



My adoption of the general form of the bridge rail, instead of the T rail, will, I presume, require no arguments in its favour. Where *cast* iron is used, the question does not involve so much difficulty as in the case of rolled iron.

As the propriety of introducing *cast* iron for rails depends much, if not *essentially*, on the securing of a firm support for it, I intend to reject the common wooden superstructure of mud sills, cross ties, and longitudinal, or string pieces, respecting which I believe almost every engineer will unite with me in saying, that it is *impossible*, (although I do not admire that term,) to joint its several parts so perfectly as to prevent derangement. For this very unstable foundation I shall substitute stout piles, from twelve to eighteen inches in diameter, well *charred*, and driven into the graded surface at intervals of three feet from centre to centre, until their resistance to the ram denotes that all chance of future yielding is prevented. Their heads will be left but some three inches above ground. As the soil of all my embankments is a very firm gravely loam, well compacted in regular layers of but one foot in thickness, I might possibly omit the introduction of *cross ties*, until experience showed whether or not they were necessary. But it is my intention to insert *iron tie rods* believing that they will be found advisable. In cases where the embankments of a road have not been carried up in such a manner as to prevent settlement, I would prefer to drive the piles through to, (or even *into*,) the original surface; for although I look upon piles as being the best of supports for rails, *where they are driven into a firm foundation*, yet I consider them, perhaps, the *worst* of all, when that point is disregarded. I shall resort to *charring* in preference to *kyanizing*, on the score of trouble and expense. Indeed I am not certain, but it is nearly as effective a remedy for rot, especially under ground. The *head of the piles* might, if appearances should indicate its utility, be washed occasionally with a solution of corrosive sublimate, or some other preservative. I do not apprehend that the friction from driving will rub off the charred surface to an injurious extent.

Piles for railroads, will, I doubt not, soon supersede all other foundations. In addition to their perfect efficiency, when properly employed, they form a *cheap* road; cheaper than the ordinary methods of construction. A road of prepared timber, properly driven, securely tied transversely, and carrying a heavy cast rail, will, I venture to say, cost greatly less than many of the roads already constructed in this country, *and be kept in repair at comparatively a very trifling expense. Indeed, until a perfectly unyielding support is found for the rail, and entire inflexibility attained in the rail itself, I conceive railroads to be in their infancy.* Nor do I at all yield assent

to the current opinion, that to attain these desiderata, will be attended by an enormous increase of expense. *I maintain that railroads have already reached their maximum of cost; and indeed that they have exceeded what is necessary to form a perfect railroad.* Perhaps hollow *cast iron pipes* might in some instances be substituted for *wooden piles.* They would be far more expensive, but still make a cheaper road than some of the plans most in vogue at the present time. It will not be, until we construct railroads on these principles, getting rid of the annual repairs of *way*, and to a great degree of *cars*, that the railroad system will develope itself in all its glory; and securely bid defiance to the rivalry of canals, steamboats, and turnpikes. The attainment of a smooth, unyielding surface, I consider a matter of paramount importance, even to that of low grades.*

J. C. T.

* Having had no experience in the use of piles *for supporting rails*, and being unwilling to incur any risk of failure by substituting a somewhat novel mode of construction, for one whose merits, and demerits have been fully tested in practice; and moreover, not having the pleasure of a personal acquaintance with any of the Civil Engineers who have been engaged in the construction of *piled* roads in the Eastern States, I gladly avail myself of the medium of this Journal, to solicit from such of them as may be willing to communicate the result of their experience, answers to the following queries. And let me here suggest, that, since the design of establishing a Society of Civil Engineers in the United States has failed, perhaps the principal object of such an institution would be secured, by the general adoption of this mode of seeking information through the Journal.

Query 1st.—Is there any danger that the vibration of the soil, from the passage of trains, may loosen the earth in contact with the piles, so as to allow of the admission of water, or of lateral displacement? especially in curves, and near the edges of embankments?

2nd.—What length of pile has experience proved to be sufficient for the prevention of lateral yielding, in the above cases, (supposing the use of 3×8 cross ties, or of iron rods;) and also in cuts, or a firm natural surface?

3rd.—Are there any roads, or *detached portions* of any road, on which the piles *have not been driven through the embankments entirely down to the natural surface;* and if so, how have they answered.

4th.—Does the security of a piled road against *vertical* displacement fully compensate for its *greater tendency to lateral* motion?

5th.—What is the comparative *annual expense of repairs*, between a piled road and one of the ordinary construction of mud sills, cross ties and strings?

Any replies to these queries, either through the medium of the Journal, or by private letter, will be thankfully received. I should prefer the latter on account of time. Permission to publish might be granted in the letter, and if so I will hand it over to the Actuary of the Franklin Institute. It will afford me much pleasure to reciprocate such favours whenever the opportunity offers.

Practical & Theoretical Mechanics & Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Blast Furnaces for Iron Smelting. *By* S. W. Roberts, Civil Engineer. No. 1.

Old Cattawissa Furnace, Columbia county, Pennsylvania. W. C. Leavensworth, lessee. Observations made October 13th, 1841 Working with charcoal and a cold blast.

Stack twenty-eight feet high; lined with slate. Boshes seven feet four inches, and tunnel head sixteen inches in diameter. Hearth stones siliceous conglomerate. Water power from Furnace Run.

Width of trunk fourteen inches, cross section of flowing water half a superficial foot, flows seventy feet at the rate of one foot per second. Falls twenty-five feet. Water equals half a cubic foot per second, or thirty cubic feet per minute. 62½ lbs. $\times$ 30 = 1875 lbs., falling per minute, multiplied by twenty-five feet fall = 46,875 lbs. falling one foot per minute; being, without deduction for loss, about one and a half horse power of Watt's steam standard. And deducing one-third, according to Smeaton's rule, shows that the power exerted does not exceed *one* horse power, which is very small when compared with the iron made. Water wheel is thirty-two feet in diameter, or one hundred feet in circumference, and turns once in eighty seconds, or at the rate of one and a quarter feet per second. The water is applied twenty-five feet above the bottom of the wheel, which is old and leaky.

There are two single-acting, wooden, blowing-tubs, each six feet five inches in diameter, three feet ten inches stroke; giving six tubs full of air for each revolution of wheel. Area of a tub 32.37 feet; stroke 3.83 feet; contents 124 cubic feet $\times$ 6 = 744 cubic feet of air blown per revolution of wheel in eighty seconds; equal *five hundred and fifty-eight cubic feet of cold air per minute*—blown through a single tuyere about two and three-fourth inches in diameter.

Last week the furnace made eighteen tons of grey pig-iron, being 40,320 lbs. of iron. In the week the furnace took one hundred and sixteen charges, called "half-charges." Each half-charge had nineteen boxes of raw ore. (Bloomsburg calcareous ore, broken to the size of Macadamized stone.) Each box contained thirty-five pounds of ore. 35 $\times$ 19 = 665 lbs. ore $\times$ 116 half-charges = 77,140 lbs. ore per week. Each half-charge had one box of forge cinder weighing thirty-five pounds $\times$ 116 = 4060 lbs. cinder. 4060 + 77,140 = 81,200 lbs. of ore and cinder, which yielded 40,320 lbs. of iron—being very nearly

fifty per cent. Forty-five pounds of broken limestone to a half-charge $45 \times 116 = 5220$ lbs. limestone per week.

Seven baskets of good charcoal to a half-charge, averaging three and a quarter bushels each, $7 \times 3\frac{1}{4} = 22.75$ bushels $\times 116 = 2639$ bushels charcoal per week, which, divided by eighteen tons of iron made, gives *one hundred and forty-seven bushels of charcoal per ton of iron.*

Eighty-one thousand two hundred pounds of ore and cinder, divided by eighteen, will give four thousand five hundred and eleven pounds, or *two tons and thirty-one pounds of ore, &c. per ton of iron.*

Five thousand two hundred and twenty pounds of limestone divided by eighteen, will give *two hundred and ninety pounds of limestone per ton of iron.*

Estimating twenty pounds of carbon in a bushel of charcoal; $2639 \times 20 = 52{,}780$ lbs. of carbon per week; and five hundred and fifty-eight cubic feet of air per minute $\times 10{,}080$ minutes in a week $= 5{,}624{,}640$ cubic feet of air per week, which divided by fifty-two thousand seven hundred and eighty pounds of carbon, will give *one hundred and six cubic feet of air blown per pound of carbon consumed.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On White Lead. By James C. Booth.

The large quantities of white lead employed as a pigment by our painters, the number of patents which have been issued abroad, proving its extensive employment, the large amount of capital invested in its manufacture, bespeak a material of no ordinary importance, and lead us to enquire whether the processes by which it is produced may not be improved relatively to economy and convenience. Undoubtedly one method by which this end may be attained is by a thorough knowledge of the chemical principles which are involved in its production, ere we can take a higher step in the application of chemistry to its improvement; and it is to this point the following remarks will be directed, by investigating the theory of the processes which are now pursued.

There are three principal modifications of the processes for producing white lead, which will include all the patents that have been granted, subject of course to such variations as secure the privileges of numerous patentees. They are those in which the formation of white lead is in whole, or in part, induced by atmospheric agency, those operating by single, and lastly those by double elective affinity.

I. *Triturating Processes.*—1. The earliest account which I have

been enabled to procure of the manufacture of white lead by the action of atmospheric agents alone, or in chief part, will be found in this Journal, vol. i, 3rd series, p. 158, from which it appears that G. F. Hagner obtained a patent for such a process in 1817. Finely granulated metallic lead was made to revolve in cylinders with water and a portion of vinegar, the air having access; by which means it was converted into a white substance, a mixture of carbonate and hydrate, as we shall find below. When used as a pigment, this white lead was very liable to become yellow, in consequence of which the process was so varied as to fall more evidently under those dependant on single elective affinity. The manufacturers performed upwards of two thousand experiments in the course of five years, and produced an article of such a quality that in 1826 they obtained a premium for it from the Franklin Institute.

2. In 1818, J. Richards obtained a patent for a process on similar principles, excepting that he appears to have employed only lead, air and water, (Jour. Frank. Inst. vol. xxvi, pp. 125, 175.) The white lead was deficient in color and body, as may be seen in the Technical Collection of the Franklin Institute.

3. In the Lond. Jour. of Arts & Science, vol. v, 1835, may be found a patent of Torassa, Muston and Wood, in which granulated lead was shaken in a moistened state on trays and the comminuted gray mass exposed to the air until a white lead was formed. From the date of the patent, 1833, it is very possible that the first ideas of the process were derived from G. F. Hagner, while the latter was in England in 1817–18, (Jour. Frank. Inst., vol i, 3rd series, p. 159.) "It is said that upwards of £100,000 have been expended at Chelsea, by a joint stock company—for executing this most operose and defective process." (Ure's Dict., p. 1300.)

4. Notwithstanding the ill success of these processes, we find another patent, (Jour. Frank. Inst., vol. xxvi, p. 119,) taken out by Homer Holland, in which the same mode of making the white oxide, &c., is claimed by the patentee, excepting that to make the carbonate, he introduces a portion of carbonate of soda into the water. In an amended patent (1838) he claims the use of any alcaline salt or substitute, whose elements consists of oxygen, carbon and hydrogen instead of alcaline carbonates.

5. The Jour. Frank. Inst., vol. xxvi, p. 123, presents another patent by Smith Gardner for making white lead by attrition, with this variation, that the operation is conducted in close vessels into which carbonic acid and air are driven during the attrition, thereby presenting them, says the patentee, "to the suboxide of lead in its nascent state.

"By introducing a very small portion of vapour of vinegar" with the gases, a superior article is at once obtained perfectly free from color.

Before passing to a consideration of the principles involved in the above processes, we may be allowed to remark, 1st. That by a comparison of the dates of the 2nd and 4th patents, it is clear that it would be very advisable for patentees to examine previous patents on the same subject, before they lay open their patent to legal attacks and flaws. 2nd. That by comparing the 3rd patent with the first two, it is evident that a vast amount of capital might be saved by first ascertaining what results others have obtained before we enter the same field of research. 3rd. That the 4th patent shows that to give a clear scientific view of a chemical process, something more is requisite than a superficial knowledge of the science, for in the patentee's first project, he calls the compound produced by attrition of lead a suboxide, and in the amended project he is constrained "to disclaim the opinion, that plumbic pulp, under any circumstances, can be considered a definite compound, and much less an oxide; but that it is a compound of lead, into which the elements, hydrogen, carbon and nitrogen, enter, as well as oxygen." Neither of these views being correct, it would have been better to have avoided such theoretic expressions altogether.

Bonsdorf* exposed a clear surface of lead to moist air which soon coated it with suboxide. A similar piece of lead laid in pure water containing air soon began to form a cloud of hydrated oxide of lead, which dissolved in the water. The smallest quantity of foreign matter, particularly of a saline nature, except nitrates, prevents this action; and so delicate is the test that Bonsdorf thinks it may be employed to try the purity of water, by throwing filings of metallic lead on the surface and observing a few minutes whether the small cloud of hydrate appears; which only occurs when the water is pure. This fact shows why the first project of the 4th patent could not be successful, by introducing a carbonated alcali into the water in which metallic lead was triturated to form an oxide and from that a carbonate, even if there were no other grounds to repudiate such a process. So far from accelerating it must have retarded the operation.

Bonsdorf found still farther that if, instead of permitting the lead to form a hydrate by resting in the water, it were put into a flask and the latter closed up and shaken, suboxide alone formed on the surface. He explains the fact on the theory, that when the lead is at rest, electric currents are formed between the metal and its oxidized points, which determine a higher oxidation, even as far as red lead, according to his observations, while by shaking, the currents are disturbed, and the whole surface of the lead becomes suboxidized, which prevents further oxidation even if left at rest. Hence it follows

* Berzelius Jahresbericht, 1837.

that the lead must first be uniformly suboxidized by trituration, and as it passes into a higher state of oxidation takes up water and carbonic acid, but in the 3rd patent a portion of the oxide and carbonate evidently formed after exposure to the atmosphere. It is probable that in all such cases where carbonic acid is not artificially used, a certain quantity of that acid will be absorbed by the oxides upon exposure to the air subsequent to attrition. The comminuted lead when taken from the trays, where the lead was only moistened, has the dark gray color of suboxide, and first assumes its white appearance by exposure to the atmosphere.

The same chemist exposed a lead plate to moist air until the whole surface was suboxidized, then removed it from a portion of the surface and covered this with water, at which place a vegetation was formed, which he found to consist of one atom of carbonate, and one atom of hydrate of lead. It is therefore a simple hydrocarbonate of lead. This is, in all probability, the substance that is formed in the first four patents, where carbonic acid was not artificially introduced; for where the quantity of this acid is as small as that contained in the atmosphere, and, where the tendency of the lead is also to form a hydrate, it is not probable that this acid should in its very diffused state usurp the place of much of the hydrate.

When vinegar is introduced in these processes, another operation takes place, which induces the more rapid formation of an oxide of lead, preventing at the same time the formation of as much hydrate, and the acetate which forms being simultaneously decomposed by carbonic acid, the vinegar as rapidly passes to another portion of oxide.

In Bonsdorf's experiments the hydrocarbonate was tried as a pigment and found to possess little body, a circumstance which will probably hold good with nearly all white lead made by the above processes, excepting the last, and the modified operations of the first, patent. In the fifth patent carbonic acid is forced in with atmospheric air and probably acts in part catalytically by inducing the formation of oxide, and in part by uniting with the oxide "in its nascent state," and thereby preventing the formation of as large a quantity of hydrate. It is said moreover that the white lead thus obtained is equal to that manufactured by the older processes, (Jour. Frank. Inst., vol. xxvi, p. 125,) but I question whether it will be found to contain a requisite quantity of carbonic acid to prevent its liability to become yellow. It remains to be seen, however, whether by any one of these processes, in which trituration of metallic lead is the chief point, the mingled hydrate and carbonate of lead contains a sufficient amount of carbo-

nate to prevent its becoming yellow by employment as a pigment; for that was the chief difficulty experienced by the first patent, and probably will be an objection to all the others; and it will be shown below that the more highly carbonated the lead is, the less it is subject to this change. The economy of the process of attrition certainly demands attention, as well as the simple arrangements by which it may be effected, but then the question returns, whether the tendency to become yellow by exposure to the atmosphere, or of vapors, can be obviated by giving the highest dose of carbonic acid, partly by driving that gas through the apparatus, and partly by introducing another ingredient into the water employed. If this point be attained, the question may again be asked whether body can be given to the compound, and whether it can be thus made destitute of a crystaline structure, for in the experiments of Bonsdorf, given above, the vegetation evinced a strong tendency to crystalization, and it appears that the same objection is generally urged against white lead made by attrition, viz: it is deficient in body.

If the theory advanced in the fifth patent (Jour. Frank. Inst., vol. xxvi, p. 123) be correct, that the white lead formed by attrition, where carbonic acid is presented to oxide of lead in its nascent state, is possessed of body and a good color, then we may hope that the process of attrition may yet be productive of good results. It should not be forgotten, however, that in all these processes carbonic acid is really present and in considerable quantity, if we suppose a large amount of air to pass over the agitated lead, but then the quantity, relatively to the oxygen of the atmosphere is very small. I would suggest whether it would not be desirable to perform an experiment in a similar manner to the above, in which water may be omitted and due proportions of air and carbonic acid driven through an agitated apparatus containing simply moistened lead, either without or, perhaps better, with the aid of steam, or at a higher than the ordinary atmospheric temperatures.

II. *Processes more or less dependent on Single Elective Affinity.*—These processes all depend upon the decomposition of a subsalt of lead by carbonic acid. 1. Thènard made the first suggestion relative to the principle, and MM. Brechoz and Leseur, who arranged the contrivances for conducting the process, received a prize for their white lead. Neutral acetate of lead was digested with litharge forming a soluble subacetate, through which, diluted with water, was passed a stream of carbonic acid. Carbonate of lead precipitated and there remained a neutral acetate in solution, which being redigested with litharge, again formed a subsalt and was again precipitated as before. Thus the acetate of lead first employed was constantly used

in the operation, a small portion of new material being added each time to allow for accidental loss and waste. All subsequent patents based on a similar principle were derived from the above patent, which was carried out on a large scale by MM. Roard and Brechoz. At this day, a large portion of white lead used in France and Sweden, is similarly manufactured, and the process is also employed in Germany, England, and at one establishment in this country, in Brooklyn, New York. It is generally believed that the old processes for manufacturing white lead by using fermenting tan, &c., and that in which vinegar, air and carbonic acid are driven into chambers containing lead and vinegar, are governed by different principles, but it will be shown that they are essentially the same with those where carbonic acid is passed through a subsalt of lead.

A. Precipitating Processes.—2. It was stated above that G. F. Hagner obtained a patent in 1817 for manufacturing white lead by attrition, but that the quality of the material being inferior, the proprietors varied the apparatus and process in such a manner as to approach Thènard's method. For a more minute description of their plan, see Jour. Frank. Inst., vol. i, 3rd series, p. 158. They forced carbonic acid through a mixture of litharge, pulpy oxide produced by attrition, and vinegar, and their white lead was of such a quality as to receive a medal in 1826.

3. Button and Dyar took out a patent for making white lead, the specification of which will be found in Rep. Pat. Inv. vol. x, 1838, with a drawing illustrating the apparatus. They employed purified carbonic acid from the combustion of coke, which was passed through a mixture of litharge and nitrate of lead dissolved and suspended in water, and kept at the boiling point of water in a state of agitation by the issue of steam in the bottom of the decomposing vats. The carbonate as it formed was drawn up by a pump, suspended in water, and falling on a filter, where it remained, suffered the liquid to fall through into the first vat.

4. In the Jour. Frank. Inst., vol. xxv, p. 197, are remarks on the manufacture of white lead by Mr. Benson who is probably the same one engaged with Mr. Gossage in the manufacture, near Birmingham, England. According to their patent, they employ of vinegar $\frac{1}{100}$ of the weight of litharge, and add so much moisture to the latter that it merely "feels sensibly damp to the touch." Heated carbonic acid (from coke) is passed over this mixture in stone troughs, while the contents are powerfully stirred up, (Ure's Dict.)

5. Cory's patent in Rep. Pat. Inv., vol. xii, 1839, employs carbonic acid derived from a lime-kiln, introducing it into a chamber, the upper part or ceiling of which is perforated with numerous small holes. A

solution of subacetate of lead is pumped up to the roof of the chamber and falls through the small holes like a shower, absorbing carbonic acid in its descent.

These are the principal variations in the precipitating method of Thènard; all are referable to the same theory, viz., the decomposition of a sub-salt of lead by carbonic acid. The last is evidently the same, excepting that the operation is inverted, and instead of passing carbonic acid through the solution, the latter drops through an atmosphere of the acid. The second is somewhat analogous to the fourth patent, excepting that the latter prescribes less moisture and employs heated carbonic acid. In both, the acid operates by forming carbonate of lead from a part of the oxide in the basic acetate, while the latter, becoming more neutral, is acted upon by the excess of litharge, forming again the basic acetate, which is again decomposed. The third patent employs a basic nitrate of lead, i. e. nitrate of lead and litharge, instead of an acetate, which, together with the boiling state of the solution, constitutes its difference from the others.

According to the observations of Robiquet, Pfaff, and others, the carbonate of lead obtained by precipitation with carbonic acid is a neutral salt, consisting of one atom each of acid and base, the only water present being hygroscopic. In the Bullet. d. Sciences, &c. en Neerlande, vol. i, p. 302, Mulder has shown that the white leads of commerce consist of two atoms of carbonate of lead and one atom of hydrate, but I do not know whether he experimented on white lead precipitated by carbonic acid, among the rest; the probability is that he did, for the process is evidently similar to the older method, in which a fermenting material is employed.

The carbonate of lead formed by these processes, whether similar or not in composition to the ordinary kinds, differs in one essential point, that it will not cover as well, and has less body; and Dr. Ure appears to have first pointed out the cause of this defect; for on examining it microscopically, he found it to consist of small crystaline particles, with a certain degree of translucency. White lead produced by the older methods is superior to it in these respects, which Mr. Benson, and I think justly, refers to "its never having departed from the solid state," and that the particles "have not been at liberty to arrange themselves symmetrically." In his patent, therefore, (fourth,) he employs a quantity of moisture just sufficient to determine the action of the carbonic acid. It is said that Messrs. Gossage and Benson produce forty tons of excellent white lead per week, (Ure's Dict.,)—La Societé d' Encouragement made a large number of experiments on the various kinds of white lead, and came to the conclusion that that produced by precipitation will cover as well as

the others, but requires more coatings, that it has a degree of translucency, but that it is whiter than that made by the older process.'' (Dict. de l' Industrie, &c., Tome iii, p. 164.) It may be that this defect of body may be remedied by violent agitation during the process of precipitation, which would disturb the crystalization. If so, the third patent should produce a dense material, and it is probable that the violent stirring in the fourth may have this effect in addition to its exposing a greater surface to the action of the carbonic acid. We shall dismiss the fifth patent with the remark that the extent of apparatus required is decidedly objectionable, and that it is inefficient, since the liquid must be pumped up several times, and suffered to fall in showers, before the decomposition is sufficiently effected.

There are several points deserving of notice, relative to this mode of manufacturing white lead. The quantity of litharge obtained in different processes of the arts is greater than the commercial demand for it, and as a reconversion of it into metallic lead is attended with a loss of more than one-sixteenth of its weight, it is desirable to find purposes to which it may be directly applied, unattended with loss. These processes for making white lead are of such a character, and hence, if the best quality of white lead cannot now be made by them, it is worth devoting time to their improvement. But, again, there is a much greater nicety in conducting these operations over the old methods, and there may be introduced into them a greater certainty in regard to the amounts of the several materials employed, circumstances which certainly impart some value to them considered with reference to the health and cleanliness of operatives, and to economy to the manufacturer. Of all the processes given above I should be inclined to prefer that of the fourth patent, as being most likely on theoretic grounds to produce the best result. Before closing this portion of our subject, we must make reference to the manufactory at Brooklyn, New York, the only one in this country, as far as my information extends, where Thènard's principle is successfully pursued. The sample of white lead from this establishment, offered at the exhibition of the Franklin Institute last Fall, was considered to be about equal to the others, and spoke well for the method, if it was made on this principle, for I understand they pursue both the older and the precipitating processes.

B. Older processes.—Among these we include the old Dutch method, where a fermenting material was employed, and that which substitutes a heated chamber for the fermenting beds. The oldest among these is probably that which originated in Holland, where rolled sheet lead is placed in earthen pots containing a small quantity of vinegar in the bottom, and these pots then buried in dung, which,

by its fermentation, produces both heat, steam, and carbonic acid. This method being that which is chiefly pursued in this country, we shall not enter into technical details respecting it. The English substitute fermenting tan for dung, otherwise the process is the same. The Kremser white is produced by a variation of the same process. It is conducted in different parts of Austria, particularly at Klagenfurth, in Carinthia, and the lead, which is very pure, is obtained from Bleiberg, in Carinthia. Sheets of lead are hung in small wooden troughs, in the bottom of which is poured mixtures, varying in different establishments, sometimes equal parts of wine lees and vinegar, &c. The troughs, to the number of ninety, more or less, are placed in a chamber, each one closed up, and the whole chamber heated by a furnace to about the temperature of 100° Fahrenheit. If the heat be too high, carbonic acid escapes, and less white lead is the result. It is generally conceded by the best judges that the best Carinthian white lead is superior to all other kinds.

Now if we suppose that twenty-three out of twenty-four hundred weight of lead are converted into white lead, then for these twenty-three hundred weight may be employed nearly 1300 lb. of vinegar, of such a strength that it would convert 128 lbs. of lead into neutral acetate. It is true that in different establishments the relative quantities of vinegar and lead vary, but still the variation is an immaterial point, for the former is rarely more than the fractional part of the lead employed; thus a pint, or a half pint of comparatively weak acid is used to three pounds of lead. It is therefore clearly evident that the former theory, that vinegar both yielded oxygen and carbonic acid, or either one, to form white lead, is either wholly without foundation, or else its service in this respect would produce but a very small part of the white lead, which is actually obtained; or suppose that a bed of 6,000 pots, of ten tier, and 600 in a tier, or layer, contained one pint of vinegar, and three pounds of lead in each, and that the pint of acid contained one ounce of *dry* acetic acid; the whole bed would then contain 18,000 lbs. of lead, and 6,000 oz. of dry acid. But this acid would consist of 2852.4 carbon, 2798.4 oxygen, and 349.2 hydrogen in ounces. Then the 2852.4 oz. of carbon, if converted into carbonic acid, would take up 3,015 lbs. of lead to form a carbonate, or about one-sixth of the metal contained in the bed, while the above amount of oxygen would only take up 2,268 lbs. of lead to make an oxide, or one-eighth of the amount of metal which is present. It follows clearly that the acetic acid is neither employed to yield oxygen for oxidizing, nor carbon for producing a carbonate, to any appreciable extent, and, moreover, it should not be forgotten that a much smaller quantity of vinegar will suffice to produce a car-

bonate than is specified above. The chief products arising from the fermentation of dung are carbonic acid, carbonate of ammonia and water, the second of which may be omitted, as it arises in small quantity from tan, which is employed with success in England. The heat of fermentation then will raise vapour of vinegar, carbonic acid and water; but there is another material of value present in this process, the atmosphere, notwithstanding experiments made in Europe,* which seemed to show that its presence deteriorated the colour of the white lead; for in all the ordinary processes it must be present, and in those which follow it has been shown by direct experiment to be essential to the formation of oxide. The moisture which is present appears to act chiefly by determining the action of the other substances, and not to be decomposed, for we have no evidence of its decomposition, and the changes which ensue to the lead can be satisfactorily explained without it. It may, however, be maintained that it assists in forming oxide, but in the subsequent experiments, air being found necessary, proves that the chief use of the latter is to oxidize the lead. We have shown above that in Bonsdorf's experiments the lead will oxidize in a moist atmosphere, and that the presence of carbonic acid tends to hasten the operation, with the production of a carbonate; acetic acid, then, by its more energetic action, will surely produce an acetate, and where its quantity is small, this will be a sub-salt. But there is carbonic acid also present, and the material must be moist enough to determine its action in decomposing the acetate; while the acetic acid, thus slowly disengaged, will act similarly on another portion of the metal, or its oxide. To this it may be objected, that at length there will be a neutral salt formed, which the carbonic acid cannot decompose. It is, however, shown that this acid will decompose even the neutral salt to a certain extent, when it is in solution. It is not, however, necessary to suppose this, for during the length of time required for the conversion of the lead, the whole of the vinegar might be evaporated without its being noticed by its odour above the bed to any appreciable extent, and as each successive portion of acetate is decomposed, a portion of the acid may thus be volatilized and escape into the atmosphere. Another explanation of this presently appears. That acetate of lead is thus formed is shown from the amount of it lost upon washing white lead, which is so great that it becomes a question with the manufacturer whether it might not be re-extracted as acetate, or better in some other form. It may be farther objected that if carbonic acid is thus employed to decompose the generating acetate, why will it not do it, when a piece of the lead in a pot dips into the acid, for in this case only acetate is the result.

* Berzelius' Elements of Chemistry.

To this it may be answered that from the known superior energy of the acetic acid, it forms an acetate with great rapidity, the small crystals of it below acting with capillarity to convey the acid to the upper portions of the metallic coil, while the slowly disengaged carbonic acid can affect the merely moistened crystaline mass with difficulty, and certainly not materially, excepting on its surface. The conclusion, then, is that the process is substantially the same as in Thènard's method, after the lead is oxidized by a moist atmosphere, viz., that a sub-acetate is formed which is simultaneously decomposed by carbonic acid, and that the more neutral salt thus generated being again rendered basic by another portion of oxide is again decomposed, while the final formation of an acid salt is prevented by the gradual escape of a portion of the vinegar. We are not, however, left in doubt as to the latter point, for it has been found that a peculiar etherial substance is obtained during the process, called *acetone*, which may be obtained by passing acetic acid through a heated glass tube, or by the dry distillation of an acetate. It is composed, according to the views of the best chemists, of 3 vol. carbon + 6 vol. hydrogen + 1 vol. oxygen, and its origin from acetic acid may be thus expressed,

1 atom acetic acid, - - -	4 C + 6 H + 3 O
Subtract 1 atom carbonic acid, -	C + 2 O
There remains 1 atom of acetone, -	3 C + 6 H + 1 O

so that acetic acid is resolved into acetone and carbonic acid. By heating the neutral dry acetate of lead, it fuses and evolves carbonic acid and acetone to a given point, when it congeals and forms a basic (two-thirds,) acetate, which requires a higher temperature for its decomposition. One-third of the acetic acid in the neutral salt is thus decomposed, and there remains a basic salt.* Now if the above given explanation of the formation of carbonate of lead be correct, then from the middle, towards the close of the process, when a neutral salt will be forming, the constant presence of a considerable amount of heat will tend to form acetone and carbonic acid, the former of which escapes into the atmosphere, while the latter assists in decomposing the basic acetate which remains. The latter is thus reresolved into a neutral salt to be again subjected to the same decomposition as before. It might be supposed that this theory would account for the formation of all the carbonate of lead, but it has been shown above that the quantity of vinegar is too small as compared with the metallic lead, and from the relative amount of the two, the

* Wöhler in Berzelius' Chemistry, vol. viii, p. 698.

conversion of the greater part of the lead into its carbonate must be explained on Thènard's principle.

These views of the author were first cursorily expressed in a report by the Franklin Institute, (Journal for 1839,) and I find that the same views are held by Mitscherlich, in vol. ii. of his Elements, Berlin, 1840. Benson alludes to a similar view, (Jour. Fr. Inst. vol. xxv. p. 197,) but refers it chiefly to his process, (see above.) I have given my opinions more at large on this subject, since some of the most eminent chemists have advanced the opinion, and I believe it is generally held, that the formation of carbonate of lead by the old process depended mainly on the decomposition of acetic acid.

C. Newer processes.—I have understood that experiments were performed many years since, with the view of making white lead, by the introduction of vapour of vinegar, air, and carbonic acid, into heated apartments containing lead, but as I am unable to find the authority for this, I shall pass to those with which I am acquainted.

Mr. E. Clark took out a patent in 1828 for a process for making white lead in close chambers, heated by steam, into which he introduced carbonic acid and air, the vinegar being in a trough, and running through the chamber, and heated by steam passing through its double bottom, (Jour. Fr. Inst. vol. xxv. p. 232.) Richards' patent was taken out subsequently, and differed in the introduction of steam into the chamber, besides some minor differences of arrangement. I should suppose that the vapourized vinegar would afford sufficient steam, as in the first patent, the object being merely to ensure the action of the other materials.

It will be observed that the process, chemically speaking, is the same in these patents, as in Thènard's method, or the older processes, viz., that an oxide and acetate are formed and decomposed by carbonic acid.

The carbonate formed by the above processes, the older and newer, is composed of two atoms of carbonate, and one of hydrate of lead, but the difference between them and Thènard's lies in the crystaline granular state of the latter, while in the former "the lead has not departed from the solid state," and is therefore more compact or amorphous, and has greater body. A portion of white lead manufactured according to Clark's process was exhibited at the Franklin Institute last Fall, and pronounced equal to the others, it not being known at the time that it was thus manufactured. A sample of Richards' is in the Technical Cabinet of the Franklin Institute.

The main question relative to the newer processes touches their economy, a point which we do not propose to discuss, as foreign to the nature of this essay. Certainly they offer greater neatness of ar-

rangement, and avoid the heavy losses from breakage of pots, while the materials employed are economical, but then again they require their peculiar expenditure for the production of carbonic acid and steam.

III. Processes dependent on double elective affinity.—The principle of these processes is not novel, although various patents have been taken out latterly based upon it, depending on the precipitation of a salt of lead by a carbonated alkali. Some are simple, others of a very complicated character, as the following selections will show.

Hemming's Lond. Jour. vol. xii. Nitrate of soda is decomposed by sulphuric acid, by which nitric acid is obtained, and sulphate of soda. The sulphate of soda is decomposed by charcoal, chalk, &c., and a carbonate of soda produced. The nitric acid first obtained is employed to form a nitrate with lead or its oxide, and this in solution is precipitated by the carbonate of soda. Thus we have obtained a carbonate of lead and nitrate of soda, the latter of which is again decomposed as above. To say the least of it, the process is highly ingenious, and involves not a little chemical knowledge, while like Thènard's process the original salt is recovered, excepting an allowance for accidental waste.

Watt & Tebbutt's patent, Lond. Jour. vol. xiii. Chloride of sodium, (common salt,) and litharge are heated to make chloride of lead. Three parts of the latter are mingled with one of red lead, and sulphuric acid added, while steam heat is applied. There remains sulphate of lead, and chlorine is evolved. The sulphate is then treated with carbonated alkali, which, according to the patent, will make hydrate with a little carbonate of lead, through which carbonic acid is passed, to fully carbonate it. The chloride of lead is also treated with nitric acid, and carbonated in a similar manner. Farther, lead is dissolved in nitric acid, and precipitated by a caustic alkali, or earth. This patent is evidently complicated, perhaps too much so for practical purposes, and unless the patentee employs a mixture of carbonated with caustic alkali, I do not know how he is to obtain a hydrate with a little carbonate; I would rather reverse it, and say carbonate with a little hydrate. By employing red lead with the chloride, the metal is oxidized by it, so that chlorine, and not hydrochloric acid, is the result; but why should the evolution of chlorine be connected with a white lead establishment?

Leigh's patent, Rep. Pat. Inv. vol. xiv, 1840, employs first, nitric acid to act on galena, to obtain a nitrate of lead; 2nd, carbonate of ammonia purified from gas liquor, or from the distillation of organic substances; 3rd, decomposes the nitrate by this carbonate, obtaining carbonate of lead and nitrate of ammonia; 4th, decomposes the sul-

phate, or chloride, of lead by carbonate of ammonia. In consequence of the amount of litharge produced collaterally in several branches of art, the action of nitric acid on galena appears to be no improvement, particularly as a portion of the acid is decomposed and lost, by yielding oxygen to the lead to form the whole of the oxide. If the carbonate of ammonia can be obtained at a cheaper rate than those of soda, or potassa, and of a sufficient degree of purity, the process might be a good one, but this may be questioned, and even if a sulphate or a muriate of ammonia, be obtained, for which there is a ready sale, I question whether the process would then be economical.

It is not necessary to enumerate more of these highly chemical processes, for it must be evident to any one acquainted with the present state of chemical science, that they might be varied "ad infinitum." The main questions are the economy of the processes and the quality of the material produced. In reference to the former point, I would merely remark that I doubt much whether such processes can be successful, where the only object is the manufacture of white lead; they ought to be connected with other chemical manufactures, the various processes of which should be "dovetailed" into each other, so that collateral products may be wrought up to other products of great utility in the arts. I have not yet seen a good analysis of white lead made by these chemical processes, but from my own experiments I believe it will prove to be like the others, a mixture of hydrate and carbonate, for upon precipitating concentrated solutions of carbonate of soda and acetate of lead, carbonic acid is uniformly generated, and escapes with slight effervescence. With a pure basic acetate this does not take place, because the carbonic acid which would have escaped unites with the soda. The decompositions may be thus illustrated.

Carbonate of soda,	CO^2	Carbonic acid.
	$2CO^2$	Basic carbonate of lead.
	$3NaO$	Acetate of soda.
Neutr. acet. of lead,	$3\bar{A}$	Acetate of soda.
	$3PbO$	Basic carbonate of lead.
Carbonate of soda,	CO^2	Acet. and carb. of soda.
	$2CO^2$	Basic carb. of lead.
	$3NaO$	Acet. and carb. of soda.
Basic acet. of lead,	$2\bar{A}$	Acet. and carb. of soda.
	$3PbO$	Basic carb. of lead.

So that in either case a basic carbonate of lead results, the excess of oxide uniting with a proportion of water to form a hydrate. It would, therefore, appear that the white lead thus produced is similar to that resulting from Thènard's principle, under all its modifications.

Whether it forms as good a pigment as that produced by the older processes I cannot determine, having never heard the results of its application.

Conclusion.—Mulder, (before quoted, Bullet. d. Sci. &c., in Neerlande I., p. 302,) examined a white lead made by a process lately patented by Stratingh, and found it to consist of three atoms of carbonate, and one of hydrate. This method of manufacture, which I have not seen described, has a decided advantage over others, by its not becoming yellow in as short a time when employed as a pigment, and Mulder therefore believes that the hydrated oxide is the principal cause of this change of colour, as sulphuretted hydrogen affects the carbonate less than the hydrate. That this view is correct is shown from the great tendency to become yellow possessed by the compound containing one atom each of carbonate and hydrate. (See the commencement of this essay.) The ordinary carbonates will absorb a certain quantum more of carbonic acid, but never so much as to expel all the water and form a neutral salt. This curious fact seems to show that there is a stronger affinity between the hydrate and carbonate than between carbonic acid and oxide of lead, to form a neutral salt, and from all the above processes it is evident that there is a superior tendency to form a compound, consisting of two atoms of carbonate and one atom of hydrate.

It appears, then, from the preceding, that we are acquainted with at least three distinct varieties of white lead:

Hydrotricarbonate,	-	$(Pb\,O+H\,O)+(Pb\,O+C\,O^2)$
Hydrobicarbonate,	-	$(Pb\,O+H\,O)+2\,(Pb\,O+C\,O^2)$
Hydrotricarbonate,	-	$(Pb\,O+H\,O)+3\,(Pb\,O+C\,O^2)$

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A new method of involving Polynomials to any power. By Wm. J. Lewis, Civil Engineer.

Having directed my attention, some months since, to the method given in all our treatises on Algebra, for the involution of expressions consisting of several terms to any power, it occurred to me that a more expeditious mode might be devised, and by pursuing the investigation given below, I discovered the law by which the co-efficient of any term is found.

If we raise, by actual multiplication, any binomial $a+b$ to any power, we soon find:

First.—That the first term of the expression is a raised to the given power.

Second.—That the second term is a affected with an exponent one less than the index of the power multiplied by b, and having for a co-efficient the index of the power.

Third.—That in each succeeding term the exponent of a is one less, and the exponent of b one greater than in the preceding term.

Let an expression $a+b+c+d+e$, consisting of at least as many terms as there are units in the index of the given power, be required to be raised to the fifth power.

From what we have stated in relation to the second term of a binomial, it will be perceived, *by confining our attention to this second term, and disregarding, for the present, all other terms;* that

$$\overline{a+b}^2 = \qquad 2ab+\&c.$$
$$\overline{a+b+c}^3 = \overline{(a+b)+c}^3 = \qquad 3(a+b)^2c+\&c.$$
$$\overline{a+b+c+d}^4 = \overline{(a+b+c)+d}^4 = \qquad 4(a+b+c)^3d+\&c.$$
$$\overline{a+b+c+d+e}^5 = \overline{(a+b+c+d)+e}^5 = 5(a+b+c+d)^4e+\&c.$$

Now we know the value of the first term of the development of each of the expressions on the right of the page. Hence, *confining our attention to this first term, and disregarding all the others,* we have;

$$\overline{a+b}^2 = \qquad 2ab+\&c.$$
$$\overline{a+b+c}^3 = \qquad 3(a+b)^2c+\&c. = \qquad 3a^2c+\&c.$$
$$\overline{a+b+c+d}^4 = \qquad 4(a+b+c)^3d+\&c. = \qquad 4a^3d+\&c.$$
$$\overline{a+b+c+d+e}^5 = 5(a+b+c+d)^4e+\&c. = \qquad 5a^4e+\&c.$$

Consequently, by substitution, we have

$(a+b+c+d+e)^5$	first	term	a^5
$=5(a+b+c+d)^4e+\&c.$	"	"	$5a^4e$
$=5.4(a+b+c)^3de+\&c.$	"	"	$5.4a^3de$
$=5.4.3(a+b)^2cde+\&c.$	"	"	$5.4.3a^2cde$
$=5.4.3.2\,abcde+\&c.$	"	"	$5.4.3.2\,abcde$

Hence, if $P=$ co-efficient of $abcde = 5.4.3.2$, $\frac{P}{2}=$ co-efficient of a^2bcd, $\frac{P}{2.3}=$ co-efficient of a^3bc, $\frac{P}{2.3.4}=$ co-efficient of a^4b and $\frac{P}{2.3.4.5}=$ co-efficient of a^5.

If instead of $\overline{a+b+c+d+e}^5$ we had examined the equivalent expression $\overline{e+b+c+d+a}^5$, we should have found as terms in the development e^5, $5ae^4$, $5.4ade^3$,&c., from which we perceive that the co-

efficients of the powers of a multiplied by any number of other terms, are also the coefficients for like powers of each of the other letters multiplied by the same number of other terms.

From the results obtained in the preceding investigation we learn *that the co-efficient of the product of as many letters, as there are units (n) in the index of the powers, is* $n.\ n-1\ n-2 \ldots 3.2.1$. The introduction of additional terms into the root will not change the value of this co-efficient, as no more than n terms can enter into any expression in the development.

We also remark that a is changed into a^2 by dividing the co-efficient of the term involving a by 2, a^2 into a^3 by dividing its co-efficient by 3, a^3 into a^4 by dividing its co-efficient by 4, &c. Hence we infer generally;

That the co-efficient of a term involving a letter affected with an exponent one greater than in a preceding term, is found by dividing the co-efficient of the preceding term by the greater exponent.

And conversely; *That the co-efficient of a term involving a letter affected with an exponent one less than in a preceding term is found by multiplying the co-efficient of the preceding term by the greater exponent.*

I have demonstrated the truth of these rules for the powers of any letter united to the simple product of other letters. It remains to be proved that it is equally applicable to terms involving combined powers of letters, as a^2c^2e, a^2c^2&c. Let N be the co-efficient of a^2dc^2 and put $c=m+n$, then $\mathrm{N}a^2ec^2=\mathrm{N}a^2d(m+n)^2=2\mathrm{N}a^2dmn+$&c. Hence $\mathrm{N}=\frac{1}{2}$ the co-efficient of $a^2dmn=\frac{1}{2}$ the co-efficient of $a^2cde=\frac{\mathrm{P}}{2.2}$.

Again let m be the co-efficient of a^2c^3 and putting $c=m+n$ as before; we have $ma^2c^3=ma^2(m+n)^3=3ma^2m^2n+$&c. Hence $m=\frac{1}{3}$ the co-efficient of $a^2mn=\frac{1}{3}$ the coefficient of $a^2dc^2=\frac{\mathrm{P}}{2.2.3}$.

The same process applied to any combination of the powers of the letters, which enter into the development of the involved polynomial, will evidently shew, that the co-efficients are determined by the rules which have been given.

It will also be perceived that all similar combinations of the powers of the different terms, must have like co-efficients, and, consequently, it is only necessary to obtain one of each set of co-efficients to enable us to unite the development of the involved polynomial.

Let us now find all the co-efficients, and express in a series the value of $(a+b+c+d+e)^5$.

Here we have $P=5\times4\times3\times2=120$; and for one set of terms and co-efficients.

$$\begin{aligned}
&P\,abcde &&= 120abcde\\
&\frac{P}{2}\,a^2bcd &&= 60\,a^2bcde\\
&\frac{P}{2.2}\,a^2b^2c &&= 30\,a^2b^2c\\
&\frac{P}{2.3}\,a^3bc &&= 20\,a^3bc\\
&\frac{P}{2.2.3}\,a^3b^2 &&= 10\,a^3b^2\\
&\frac{P}{2.3.4}\,a^4b &&= 5\,a^4b\\
&\frac{P}{2.3.4.5}\,a^5 &&= a^5
\end{aligned}$$

Hence $(a+b+c+d+e)^5$

$=a^5+b^5+c^5+d^5+e^5$

$+5\,a^4\,\overline{b+c+d+e}+5\,b^4\,\overline{a+c+d+e}+5\,c^4\,\overline{a+b+d+e}+$
$5d^4\,\overline{a+b+c+e}+5\,e^4\,\overline{a+b+c+d}$

$+10\,a^3\,\overline{b^2+c^2+d^2+e^2}+10\,b^3\,\overline{a^2+c^2+d^2+e^2}$

$+10\,c^3\,\overline{a^2+b^2+d^2+e^2}+10\,d^3\,\overline{a^2+b^2+c^2+e^2}$

$+10\,e^3\,\overline{a^2+b^2+c^2+d^2}$

$+20\,a^3\,\overline{bc+bd+be+cd+ce+de}+20\,b^3\,\overline{ac+ad+ae+cd+ce+de}$

$+20\,c^3\,\overline{ab+ad+ae+bd+be+de}+20\,d^3\,\overline{ab+ac+ae+bc+be+ce}$

$+20\,e^3\,\overline{ab+ac+ad+bc+bd+cd}$

$+30\,a^2b^2\,\overline{c+d+e}+30\,a^2c^2\,\overline{b+d+e}+30\,a^2d^2\,\overline{b+c+e}$

$+30\,a^2e^2\,\overline{b+c+d}+30\,b^2c^2\,\overline{a+d+e}+30\,b^2d^2\,\overline{a+c+e}$

$+30\,b^2e^2\,\overline{a+c+d}+30\,c^2d^2\,\overline{a+b+e}+30\,c^2e^2\,\overline{a+b+d}$

$+30\,d^2e^2\,\overline{a+b+c}+60\,a^2\,\overline{bcd+bce+cde}+60\,b^2\,\overline{acd+ace+cde}$

$+60\,c^2\,\overline{abd+abe+bde}+60\,d^2\,\overline{abc+abe+bce}+60\,e^2\,\overline{abc+abd+bcd}$

$+120\,abcde.$

Again, let it be required to find the co-efficients of $(a+b+c)^3$.

Here $P=3\times2=6$, and the following terms involve the required co-efficient; $P\,(6)\,a\,b\,c$, $\frac{P}{2}(3)\,a^2\,b$ and $\frac{P}{2.3}\,(1)\,a^3$.

As a third example, let us find the co-efficients of $(a+b+c+d)^4$.

Here $P=4\times3\times2=24$, and the following terms include the co-efficients; $P\,(24)\,a\,b\,c\,d$, $\frac{P}{2}\,(12)\,a^2\,b\,c$ $\frac{P}{2.2}\,(6)\,a^2\,b^2$ $\frac{P}{2.3}\,(4)\,a^3\,b$, and $\frac{P}{2.3.4}\,(1)\,a^4$

It is manifest that in all these examples, we could have commenced with the co-efficient of the highest power of a, that is with units, and deduced from thence the remaining co-efficients by successive multiplications and divisions. The expansion of $\overline{a+b+c+d\ \&c.}^n$ will exhibit this process in its most general form; it will be $\overline{a+b+c+d,\ \&c.}^n$

$$=a^n+n\,a^{n-1}b+n.\overline{n-1}\,a^{n-2}b\,c+n.\,\overline{n-1}.\,\overline{n-2}\,a^{n-3}bcd+n.\,\overline{n-1}.\,\overline{n-2}.\,\overline{n-3}\,a^{n-4}bcde+\&c.$$

$$+n.\,\frac{n-1}{2}\,a^{n-2}b^2+n.\,\frac{n-1}{2}\,\overline{n-2}\,a^{n-3}b^2c+n.\,\frac{n-1}{2}\,\overline{n-2}\,\overline{n-3}\,a^{n-4}b^2cd+\&c.$$

$$+n.\,\frac{n-1}{2}\,\frac{n-2}{3}\,a^{n-3}b^3+n.\,\frac{n-1}{2}\,\frac{n-2}{3}\,\overline{n-3}\,a^{n-4}b^3c+\&c.$$

$$+n.\,\frac{n-1}{2}\,\frac{n-2}{3}\,\frac{n-3}{4}\,a^{n-4}b^4+\&c.$$

If c, d, &c. each becomes o, the root reduces to a binomial, and all the terms containing these letters disappear from our expression of the power. Consequently we have,

$$\overline{a+b}^n=a^n+n\,a^{n-1}b+n\,\frac{n-1}{2}\,a^{n-2}b^2+n.\,\frac{n-1}{2}\,\frac{n-2}{3}\,a^{n-3}b^3+\&c.$$

which is the well known binomial theorem. Where the exponent of the power is not much greater than the number of terms in the root it is better to commence with the co-efficient P, supplying the place of the number of terms which are necessary to make the whole number of terms equal to the exponent of the power, by other letters, the value of each of which is of course nothing. The terms involving these letters are evidently nothing, and the only object of their introduction is to facilitate the calculation of the co-efficients of the remaining terms.

Thus were it required to find the co-efficients of $\overline{a+b+c}^5$, they would be most readily found, by first obtaining the co-efficients of $\overline{a+b+e+d+e}^5$, as in our first example, and then rejecting the first two results, which involve d and e. But where the number of terms is small, and the exponent of the power large, it is more convenient to find the co-efficient of a binomial in the usual manner, and obtain from thence the additional co-efficients, which enter into the power in consequence of the introduction of other letters into the root. For an example, find the co-efficients of $\overline{a+b+c}^{10}$. Here the terms involving the binomial co-efficients are $a^{10}+10\,a^9b+45\,a^8b^2+120\,a^7b^3$

$+210\,a^6b^4+252\,a^5b^5$, and the introduction of the third term c gives us the following and similar terms.

$$90\,a^8b\,c+360\,a^7b^2c+840\,a^6b^3c+1260\,a^5b^4c$$
$$+1260\,a^6b^2c^2+2520\,a^5b^3c^2$$
$$+3150\,a^4b^4c^2+4200\,a^4b^3c^3$$

We may also remark that the co-efficient of any term is easily found without regarding the co-efficient of any other term. Thus the co-efficient of $a^5b^3c^2$ in the above example is evidently

$$\frac{10.9.8.7.6.5.4.3.2}{(5.4.3.2)(3.2)2}=\frac{10.9.8.7.6}{3.\ 2.2}=2520.$$

Here the numerator represents the value of P, and the denominators the several divisors used in converting products to squares, squares to cubes, &c. The general expression for the co-efficient of $a^rb^sc^t$ is (putting $n=r+s+t=$ the exponent of the power)

$$\frac{n.\,\overline{n-1}\,\overline{n-2}\,.\,.\,.\,.\,.\,.\,.\,.\,.\,\overline{r+1}}{(s\,.\overline{s-1}\,.\overline{s-2}\,.\,.\,.\,.\,3.2)\,(t.\,\overline{t-1}\,\overline{t-2}\,.\,.\,.\,.\,3.2)}$$

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Tatham & Brothers' Lead Pipes.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Patent Improved Leaden Pipe manufactured by Messrs. Tatham & Brothers, of Philadelphia, Pennsylvania, Report:

That they have carefully examined many specimens of these pipes selected by themselves and subjected them to repeated trials by a suitable force pump. The pressure was cautiously increased until the bursting point was attained, in every instance, and the phenomena accurately observed. From the result of these trials the committee are unanimously of opinion that these pipes possess some important advantages over those heretofore used.

1st. *The strength* is equal to the maximum strength of lead due to the form and weight of the tube; thus exhibiting a rare coincidence between theoretical and practical perfection in this respect. The uniformity of the thickness and perfect accuracy of the bore which are attained by the mode of manufacture ensure this invariably. Experiments on the strength of leaden pipes exhibit many discordant and embarrassing characters which have occasioned the Committee some

anxiety. It is well known that the presence of a small proportion of tin, or other metal with which lead is usually alloyed, always affects its hardness and strength—so that pipes made precisely in the same manner, of lead procured from different, and even from the same mines, vary exceedingly in strength. This source of error cannot be ascertained without great difficulty, and the Committee have taken it into consideration.

2nd. *Absence of Flaws.*—As the metal is forced out from the reservoir under enormous pressure, whilst acquiring its form, flaws are avoided, which so often exist in the ordinary castings. It is moreover probable that such pressure whilst consolidating the metal, contributes to its strength.

3rd. *Absence of Scales of Lead and Polish of the Interior.*—These pipes are perfectly clean within, and from the mode of making them must necessarily have this desirable property. The perfect polish also facilitates the motion of fluids.

4th. *Uniformity of Bore.*—The calibre is capable of being made precisely the same throughout, while the common leaden pipes may vary even when made with great care.

5th. *Economy of Metal*—resulting from the concentricity of the interior and exterior surfaces no metal is wasted from variation in thickness.

6th. *The longer lengths* requiring fewer joints, thus diminishing the expense and inconvenience of soldering. These pipes can be made in lengths of from 40 to 300 feet, according to their weight.

7th. Facility of making pipes of large diameter which the Committee believe to be almost impracticable by the ordinary methods, but which may nevertheless be sometimes demanded in the arts.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, Nov. 11, 1841.

Report on Greenough's Patent Lamp and Chemical Oil.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the patent lamp and chemical oil, invented by Mr. B. F. Greenough, of Boston, Massachusetts, Report,

That the lamp is one contrived for the purpose of burning those compounds analogous to camphene, which require for their perfect combustion, a strong draft, and a carefully regulated supply of air.

The lamp consists of an inverted bell-shaped reservoir, through the centre of which passes a tube, open at both ends, the upper end

of which is about one and a half inches above the reservoir, while the lower extremity has a free access to air, as in the ordinary Argand lamp.

This tube, of course, passes air-tight through the reservoir. Concentric with this, and surrounding it, is another metallic tube, starting about one-sixteenth of an inch below the upper edge of the wick, and passing down nearly to the bottom of the reservoir, where it terminates. Into the space between these two tubes, the wick, itself secured upon another tube, passes, and rises about three-fourths of an inch above the upper edge of the inner air-tube. In consequence of this arrangement of the wick, the lamp, when filled, may be inverted, or even rolled over the floor, without losing any of its contents.

The top of the reservoir is made flat, and upon it rests a slightly conical tube, a little more than two inches in height, expanded below into a flat zone, around the circumference of which apertures are provided, for the introduction of the air, which is delivered at the upper end of the tube, around the outer circumference of the flame. Along the axis of the inner air-tube passes a metallic stem, which carries, at its upper extremity, a button, or reverberator, of a diameter rather larger than that of the tube upon which the wick is secured. This button may be raised or lowered at pleasure, by means of the stem, and by it the height of the frame is regulated, and perfect combustion insured. The glass chimney is about one foot in height, swelling slightly at the part opposite the flame, and thence gently tapering to its upper extremity.

By means of the contrivances thus described, a constant and steady access of air is secured to the flame, while the effect of any draught, or sudden current, is in a great measure counteracted. The lamp thus burns steadily, and without any apparent flickering irregularity.

The substance proposed to be burned in these lamps, is what is termed by the inventor, "chemical oil." It is evidently derived from oil of turpentine, but the exact chemical composition of it is, to the committee, unknown.

In regard to the light obtainable from the chemical oil in the lamp thus constructed, as well as the economy to be expected from its use, is subjoined the results of the experiments instituted by the sub-committee.

A lamp containing a pint and half a gill of the oil, was suspended and lit precisely at twelve o'clock. The draught was so regulated as to increase the consumption of the material, as far as it could be done, without giving rise to smoke—and that this was the case, was rendered evident from the odour of the unburned oil, which pervaded the room during the day. At eight and a half o'clock, the wick being

considerably clogged, and the light, in consequence, diminished, the lamp was extinguished, and the consumption was found to be five-eighths of a pint. The cost of the oil being one dollar per gallon This gives an average expense of nine-tenths of a cent per hour. The inventor states the average expense at one cent per hour.

In regard to the intensity of the light, the same lamp regulated, as far as possible, to the same height, was compared with the Argand gas burner, in the committee room, which is a burner of a little less than three-fourths of an inch, and consists of eighteen jets. This light was estimated by Mr. Cresson to be consuming about four and a half cubic feet per hour, which, at the present price of gas, is an expense of 1.575 cents per hour. The relative intensity of the light, (estimated as proportional to the squares of the distances of the centres of the respective flames, from the centre of the photometer, when the lights were equalised,) was 702.25 for the gas; 1482.25 for the chemical oil; or a little more than two to one in favour of the chemical oil.

By the kindness of Mr. Cresson, the committee were furnished with a remarkably fine Argand lamp, with an adjustable chimney, by means of which the draught of air could be regulated to every height of the wick. With these two lamps the relative intensities were—for the Argand lamp, 495.0625; for the chemical oil, 1122.25; or 2.26 to 1 in favour of the chemical oil.

An experiment was then tried with two of Mr. Greenough's lamps, one being filled with the chemical oil, the other with Dyott's pine oil. The relative intensities were for Dyott's pine oil, 1089; for the chemical oil, 1225; or 1.125 to 1 in favour of the chemical oil.

In these experiments, the distances from the centres of the respective flames to the centre of the photometer, when the lights were equalized, were as follows, viz:

From the gas Argand burner, 26½ inches; from the chemical lamp, 38½ inches.

From the oil Argand burner, 22¼ inches; from the chemical lamp, 33½ inches.

From the lamp with Dyott's oil, 33 inches; from the chemical lamp, 35 inches.

It should also be remarked that the lamps, burning during these experiments for about two and a half hours, exhibited much less clogging of the wick than in the experiment upon the quantity of oil consumed, and the smell was also much less.

The question of the relative adaptation of oils of this nature, and of ordinary sperm oil, for domestic purposes, will be settled by every one, according to their individual impressions in relation to the danger

in using a substance much more inflammable than common oil, and their estimate of the security attainable from care and proper attention.

This question does not seem, to the committee, to be within their province. Perhaps, however, it may be considered that the greater inflammability of the chemical oil is somewhat compensated by the fact that when spilled upon a surface it leaves no stain.

These questions being left for individual consideration, the committee can, with safety and pleasure, recommend Mr. Greenough's lamp, as admirably adapted for the purposes for which it is intended, and as exhibiting a gratifying specimen of our arts in the gracefulness of its design, and the beauty of its finish.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

Philadelphia, Nov. 11th, 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1840.

With Remarks and Exemplifications by the Editor.

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1. For improvements in the *Steam Engine applied to Locomotive purposes and Steam Navigation;* John Ericsson, of the Kingdom of Sweden, now residing in New York, November 5.

The claim appended to the specification of this patent will give a sufficiently clear idea of the invention; it is as follows, viz. Having thus fully described the nature of my invention, and shown the manner in which I carry the same into operation, I do hereby declare that I do not claim to be the inventor of steam engines having radial pistons which vibrate or perform partial rotary movements within semi-cylinders, or other segments of cylinders, such engines having been before known and used; but what I do claim as my invention, and desire to secure by letters patent, is the propelling of steam carriages by the combining of two semi-cylinders, each furnished with radial pistons, which pistons vibrate within them, said semi-cylinders being placed on a level with each other; and the shafts, or axles, of their radial pistons extending through the cylindrical covers in opposite directions beyond the sides of a locomotive carriage, and having crank levers attached to their outer ends, which crank levers are connected by suitable rods, to crank pins on the driving wheels. The respective parts being combined and arranged substantially in the manner herein set forth. I likewise claim the employment of the same apparatus for the driving of the propelling, or paddle, wheels of such vessels as are propelled by the power of steam; the general arrangement and operation of the respective parts being substantially the same with those by which said combined semi-cylinders are adapted to the propelling of loco-

motives, with such variations of arrangement only as are required by the nature of the case, and as herein fully pointed out and made known. I also claim the combining of the double semi-cylindrical air-pump with my double semi-cylinder steam engine, constructed and arranged as herein set forth. Said air pump having a radial vibrating piston, and self acting valves, and being arranged and connected with the other operating parts of the engine, substantially as herein described."

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2. For an improvement in *Portable Ovens and Stoves;* Edward Gosselin, city of New York, November 7.

This patent is for adapting a portable and shifting oven to a cooking stove, the draught of which passes under the top plate. The top plate of the stove is provided with two apertures, one near the front, and the other near the chimney; there being a damper in front of the rear aperture, which, when opened, admits the draught to pass directly out at the chimney, and when closed directs it around the oven, the flue of which is made to fit the two openings in the top plate of the stove, so that the draught passes up at one end of the oven, over the top, down the back and out at the chimney.

Claim.—"What I claim as new and of my own invention, and desire to secure by letters patent, is not the mere combination of a portable oven with a cooking stove, as this is not new, but the combining the oven with the stove in the manner herein set forth, so that the draught from the stove shall pass up on one end of the oven, over the top, and down on the opposite end into the common flue of the stove; that is to say, I claim the combination of an oven constructed in the manner herein set forth, with any cooking stove adapted to receive it, and so regulated as to admit the draught either to pass over the oven and thence into the common flue, or to pass directly into the flue without circulating over the oven, the whole being constructed substantially in the manner herein set forth."

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3. For making *Water-proof Trunks;* Peter Getz, Lancaster, Pennsylvania, November 7.

The proposed improvement is adapted to the common trunk, the space in the top, or lid, being made air tight with tinned copper. A box that fits into the body of the trunk, is also made of tinned copper, covered on the top with wood. Into this top is made a hole with a metal ring fitted to it, to receive a cover that screws into this ring, there being a similar ring attached to a copper plate which constitutes the cover. The key hole is made water tight by a screw cap in the same manner with the cover of the box. The whole being thus made water tight, and the upper part or lid of the trunk being an air chamber, the articles contained in the box will not only be preserved from moisture, but the whole may be used as a life preserver.

The claim is confined to the "method described of rendering trunks

water-proof by constructing them with a screwed plate, or lid, in the manner set forth."

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4. For an apparatus for *Cooling Mash in Distilling Operations;* Allen D. Ward, Mason county, Kentucky, November 7.

The improvement which is the subject of this patent is applied to the common mash rake. A water receiver is placed on the top of the rake beam and surrounding the shaft, and another at the bottom of the mash tub, and also surrounding the shaft. Two pipes, one on each side, extend from the upper to the lower receiver; they are curved so as to extend from the upper receiver to the outer rake teeth, in front of which they are then curved and run up in front of the next teeth, and so on until they reach the receiver at the bottom of the mash tub. Water is supplied to the upper receiver and passes through the serpentine pipes to the lower receiver and is discharged at the bottom thereof, and in passing through the pipes, which are carried around with the rake, cool the mash.

The claim is to the "combination of the serpentine pipes and receivers with the shaft for cooling the mash speedily in warm seasons, after the operation of mashing is accomplished."

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5. For improvements in the *Printing Press;* Stephen P. Ruggles, Boston, Massachusetts, November 10.

This press, we are told by the patentee, is principally adapted to small work, such as the printing of cards, and bills. The platen is raised and lowered by a toggle joint, and the types are placed with their face downwards, what is usually called the bed plate, being in this press placed above the platen. The paper is placed on a movable tympan plate, and the impression is given by raising the platen, which first comes in contact with the under side of the tympan plate, and forces it up, with the paper, against the types. The paper is put on and removed, and the types inked by the operation of the machinery, which is all worked by one person; but as the arrangement is necessarily complex, and the claims refer throughout to the drawings, they would not be understood if given.

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6. For an improvement in the mode of *Shifting Switches on Railroads;* Jesse La Rue, Bucks county, Pennsylvania, November 10.

In this apparatus a bar is jointed to the single or double switch, and to this bar is jointed two levers, in opposite directions, and nearly in the middle of the track—when the single switch is used, one lever is placed in the middle of each track. That end of the levers opposite to the end which is jointed to the bar, is weighted to counterbalance the weight of the switch and bar, and properly curved to be acted upon by a cam piece attached to the forward part of the car. By this arrangement the car will always act upon the switch before it is reached by the wheels when running in either direction. The cam

piece which acts on the levers is permenantly attached to the forward part of the car. The end of the rail, and of the switch against which it fits, are beveled so that stones and dirt will not be retained by them.

Claim.—"I am aware that switches have been shifted by the motion of the cars running on the rails leading thereto, and do not therefore claim this as making any part of my invention; but what I do claim, and desire to secure by letters patent, is the combination, in the manner set forth, of the switches, connecting rod, and the two levers, furnished with the curved metallic castings acting as a counterpoise to the weight of the switches, and acted upon by what I have denominated the operating power, (cam piece attached to the car,) whereby the switches may be shifted before they are reached by the car, the same being effected by the car itself, when traveling in either direction, as set forth. I also claim the beveling of the ends of the switches, and of the rails, for the purpose and in the manner above made known."

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7. For a machine for *Cutting Nails, Brads, &c.;* Geo. D. Strong and Jona. Dodge, assignees of Walter Hunt, city of New York, November 13.

This machine is principally applicable to the cutting of nails, such as were patented by Walter Hunt on the 12th of November, 1839, and noticed in the 1st volume, 3rd series, of this Journal, page 18. The cutters are made by turning, or otherwise forming, metallic staves or longitudinal sections of zones, or thimbles, so that their outer peripheries shall represent the form of one half of the nails, or brads. Two such cutters are attached, by their ends, to levers united so as to vibrate together upon gudgeons attached to their outer faces; the centre of vibration of the double lever corresponding to the centre of the circle forming the outer peripheries of the cutters. Two similar cutters, arranged in the same manner, are placed below, so that when the two sets of levers vibrate, the edges of the two sets of cutters just pass each other, they being reversed for that purpose. The cutting edges of the two cutters, on each double lever, are sufficiently far apart to admit of the passage of the bar of iron, from which the nails are cut between them during their vibration. The two sets of levers are connected together by joint links so as to insure their simultaneous vibration. Thus it will be seen that when the two sets of levers are vibrating in one direction, the cutter on one end of the lower set of levers will unite with the cutter on the other end of the upper set of levers in cutting a nail with the head on one side of the bar of iron, and when making the return vibration the other set of cutters will cut the nail with the head on the other side of the bar.

There is a spring gauge to gauge the feed of the bar at every cut—it consists of a long spring attached to the outside of one of the lower levers with a horn, or projection, passing between the two lower cutters.

Claim.—"I claim the plan of forming the cutters for cutting nails, brads, &c., from staves or longitudinal sections of metal zones, or

thimbles, in the form, or forms, specified, whether the same are first made, or turned in entire pieces and afterwards cut, or sawed, into sections, or whether said sections are fitted up separate, or made of cast steel, or other metal. I also claim in connexion with said above described cutters, or those of any other form, having similar shaped cutting surfaces, or edges, the mode of arranging the same in such manner as to operate upon the same principle of motion, that is to say, arranged in two opposite pairs fitted in levers, or other fastenings, by the vibrating motion of which levers two opposite cutters, one from each pair, is made to approximate and pass each other, operating as cylindrical shears in cuting off one nail, and as those recede, the other pair operate in a similar manner in cutting the next nail, alternately. And I further claim the combination and general arrangement of the head knives, cutters, and spring gauge, constructed and arranged as above set forth and described, without reference to the particular form of the cutting edges of the cutters for the purpose of cutting nails, brads, tacks, &c., without regard to the particular form or shape of the same."

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8. For an improvement in *Door Springs;* Wm. W. Smith and Ben. Mullikin, Jr., city of New York, November 13.

From the arbor of a crank having its bearings in a frame attached to the casement of the door, a lever projects, the extreme end of which passes through a loop in an arm attached to the upper edge of the door. The lever is at right angles to the crank, and the crank is actuated by a spiral spring, one end of said spring being attached to the crank and the other to the casement of the door. By this arrangement it will be perceived that the tension of the spring will tend to close the door until it is opened to a right angle, which places the crank in the dead point, and keeps the door open, and when it passes this point the effect will be to force it still further back.

The claim is to the "combination of the spring, crank, and lever, acting upon the arm attached to the door, or gate, in the manner and for the purpose described."

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9. For an improvement in the method of *Manufacturing Balls or Shot;* Levi Magers, city of Baltimore, November 13.

The moulds, which are to be used are made upon the sides of any number of square bars of iron, are arranged in a reciprocating carriage, so that they can be separated at the end of each operation to discharge the balls that have been cast, and then reclosed. For this purpose the bars slide on the carriage at right angles to its length, and all the bars are connected with one lever, each by a separate link, the connecting link of the outside bar being furthest from the fulcrum of the lever, and the others nearer and nearer the fulcrum, so that by one movement of the lever the bars will all be separated. A furnace and kettle, containing the lead, are arranged over the carriage of moulds, and are provided with the necessary appendages to allow the molten lead to run into the moulds as they pass under the kettle, and

to stop its flow when the carriage of moulds arrives at the end of its course.

The claim is to the combination of the furnace and kettle with the moulds, and also to the combination and arrangement of the moulds with the carriage.

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10. For an improvement in the *Windlass Bedstead;* Thomas Lamb, Washington, District of Columbia, November 13.

In this bedstead the rail and post are to be put together by a round tenon and mortise, the mortise being provided with a pin that fits in a groove turned in on the outside of the tenon. A longitudinal groove is cut in the end of the tenon which slips over the pin when the tenon is inserted in the mortise. A segment of a ratchet wheel on the end of the rail, and a pall on the post, constitute the windlass.

The claim is to the above mode of attachment in combination with the windlass.

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11. For a machine for *Sawing Paving Blocks;* Amaziah Nash, Calais, Washington county, Maine, November 13.

The blocks are to be cut by means of a circular saw, and the improvement is in the method of presenting the block to the saw. The block to be sawed is placed on the upper end of a spindle, which has its bearings in a slide, that works in, and at right angles to, the carriage. A frame is either attached to the top or bottom of the slide above mentioned, and when the frame is placed above, the block is shifted, to be cut into any given number of faces, by an index, or "notched wheel and catch," the arbor of which slides up and down by means of a lever to take hold of the block, and when placed below, the spindle on which the block is placed, has a cog wheel on it to form the connexion between the spindle and the index wheel. The carriage feeds the block up to the saw, and the slide, which works at right angles to the motion of the carriage, regulates the diameter of the block.

The claim is to the combination and arrangement of the carriage, slide, index, and saw.

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12. For improvements in the *Cooking Stove;* David H. Hilliard, Cornish, Sullivan county, New Hampshire, November 26.

The improvements described are to be appended to the stove patented by Thomas Woolson, on the 20th of July, 1831, and noticed at page 47 of the ninth volume of this Journal, second series, but they may be applied to other stoves.

The improvements consist in the manner of constructing or arranging the fire chamber, which constitutes what the patentee terms an "air tight furnace." This furnace is adapted to the hearth plate which is sunk like an ash pit, and the anterior part of the bottom is open like a grate, and to this the ash drawer is adapted. The ash drawer is made with a plate in front, so that when it is under the

grate, a draught of air will be admitted to the fire, but when the plate is pushed under the grate, then the draught will be cut off. At the posterior part of this furnace there is an opening which leads to the oven flue of the stove. When the furnace is to be used, this opening is reduced by means of a strip of metal, and when the opening is to be closed entirely it is effected by another strip of metal attached to one edge of a plate which slides on the top of the furnace and is provided with a collar and cover to receive a tea kettle or other vessel. By this arrangement the furnace can be rendered air tight.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner in which I have constructed the bottom of my fire chamber with grated openings through the anterior part thereof, and combined therewith an ash pit drawer having a flat plate in front of sufficient width to cover these openings, and an aperture in the rear for the purpose of admitting air, the whole operating in the manner set forth. And in combination therewith, I claim the strips of metal arranged and operating as described for the purpose of closing the flue space at the back of the fire chamber when required."

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13. For a musical instrument called the *Vocal, or Echo, Organ;* John W. Campbell, Attica, Fountain county, Indiana, November 26.

The object of this improvement is to modify the sound produced by the vibration of a metallic reed, by causing it to pass through chambers, called by the patentee, "vocal, or echo, chambers." Any desired number of these chambers, properly tuned, are arranged in a box which is supplied with wind from a bellows, and the outlets from the chambers are governed by stops attached to keys like those of a piano forte.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the vocal apparatus herein described, consisting of the vocal box with its vibrating tongues, as set forth, and the mouth piece and fauces attached to the same. I also claim the placing of the foregoing vocal apparatus, or such number of them as might be necessary to produce the required notes, in a box constructed in the manner herein described. The said vocal pieces being arranged beside each other and governed by stops, operated by keys for producing tone in the manner herein set forth."

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14. For an improvement in *Churns;* Constant Webb, Wallingford, New Haven county, Connecticut, November 26.

This alleged improvement in churns is in that kind which consists of four wings attached to a horizontal arbor revolving in a box, and instead of having the four wings parallel to the axis, and attached by each end to a head, they are attached to a cross at one end only, and incline from the line of the axis at an angle of about thirty degrees.

Claim.—"What I claim as my invention and desire to secure by

letters patent, is the reel, and the manner in which the agitating wing-boards are arranged upon the arms of the cross, and thus form the peculiar reel of the churn, as set forth in the specification, viz: by attaching to each arm of the cross on the arbor, or axle, an agitating wing, made fast to the arm at one end, and passing the line of the axle obliquely to the left, at an angle of about thirty degrees; each wing being about three inches broad at the end by which it is made fast to the arm of the cross and gradually reduced to about half that width, at the other end, and of such length, and so curved, as to approach but not to touch the sides or bottom of the churn, as more particularly described in my specification."

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15. For an improvement in the *Spark Extinguisher;* David Ritter, New Haven, Connecticut, November 26.

At the top of the ordinary chimney of a locomotive steam engine there is placed a cap, pierced with three holes, one at top, one in front, and the third at the back; the two former have hinged covers, which can be opened for firing up, and the other provided with a conducting tube which runs over the engine and turns down at right angles, and is to discharge the sparks, &c., into a reservoir containing water, and covered with wire gauze for the escape of the draught.

Claim.—"I do not claim as my invention, the conductor for carrying off the sparks from the chimney of the locomotive nor the openings for the draught on the top or in front of it, which openings may be used or not as occasion may require. But I do claim as my invention the combination of the cistern or reservoir of water with the conductor for carrying the sparks and dust from the chimney and depositing them perpendicularly downward in the reservoir, and thereby extinguishing the sparks and absorbing the dust, permitting the smoke only to escape from the reservoir."

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16. For a *Rotary Steam Engine;* Jacob C. Robie, Binghampton, Broome county, New York, November 26.

The engine which is the subject of this patent is very similar to many other rotary engines which have been noticed in this Journal, and as the claims refer to the drawings we will not insert them, but make the following extract from the specification, explanatory of the general combination of the instrument.

"My engine is, in its general construction, similar to some other rotary engines which have been heretofore made; my improvement consists in certain devices by means of which the friction is lessened, the waste of steam is prevented, and the valves against which the steam acts, are so constructed and arranged as to open against permanent bearings, so that their action is more perfect, and their liability to derangement much less, than such as have been heretofore constructed."

17. For *Straining and preserving Clothes Lines;* Edwin Allyn and C. B. Hildredth, Boston, Massachusetts, November 26.

The clothes line to be preserved and strained is to be wound upon a bobbin, or spool, the spindle of which is provided with a winch and ratchet wheel and pall. The spool is enclosed within a case having a sliding door in front. When the line is to be used, the sliding door is to be opened, and the end of the line passed through snatch blocks properly arranged, one of which is double, and then attached to a pin.

The claim is to the "combination of a spool, or bobbin, having a windlass ratchet wheel and catch, with a casing having a slide in front, and also with the single and double snatch blocks."

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18. For a *Thrashing Machine;* John Criswell, Cecil Township, Washington county, Pennsylvania, November 26.

This patent was granted for a mode of arranging that part of a thrashing machine by which the grain is separated from the straw, and the straw itself carried away. Behind the thrashing cylinder there is an inclined rack, made like a venetian blind, or shutter, on which the grain and straw are thrown by the cylinder. The straw is drawn up over this rack by a set of rakes, attached to an endless belt, and is discharged at the upper end of the rack whilst the grain falls through between the slats on to an inclined board, and is thence conducted to a proper receptacle.

The claim is to the "forming of the rack as an inclined plane, and carrying the straw over it by a belt of rakes."

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19. For constructing *Cabooses and other Cooking Stoves;* Loftis Wood, city of New York, November 26.

The following extracts from the specification of this patent will give the reader a very clear understanding of the improvement. "The main feature of my improvement consists in the manner in which I heat the oven used for baking, which oven is situated at the back of the fire place, or chamber of combustion, as in the greater number of cooking stoves; but in my cabooses, or stoves, I do not allow of a direct draught from the fire to pass under the oven, but cause the whole of the heated air generated in combustion to pass over the oven, in a flue space between it and the boilers, or other cooking utensils situated above it; whilst I heat the lower part of the oven by constructing the grate upon which the coal, or other fuel, is sustained, with hollow bars, which bars admit the atmospheric air freely into them in front, and open at their inner or back ends, into a flue space under the oven. I perforate the bottom plate of my oven with holes, so as to allow the atmospheric air which has passed through the grate bars, and has thereby become highly heated, to pass directly into the oven; and I also perforate the back plate of my oven with holes through which the heated air which has been admitted into it may escape into the back flue, and thence, under the government of a

damper, valve, or sliding shutter, into the flue by which it is carried to the chimney.

"What I claim," the patentee further says, "as constituting my invention, and desire to secure by letters patent, is the manner in which I construct and combine the grate bars and the oven, as herein described; that is to say, the forming of my grate with hollow bars, the openings through which lead into the flue space under the oven, for the purpose of heating atmospheric air, and conducting it into said flue space; and in combination therewith. I claim the opening through the bottom and back oven plates, for allowing the air so heated to pass into and through the oven, its passage being governed by a shutter, or damper, as described."

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20. For a *Portable Furnace for Bathing Tubs;* Randolph Densmore, Hopewell, Ontario county, New York, November 26.

The patentee says—"The kind of furnace which I have improved is that which is so constructed as to float in the water contained in the bathing tub, and in which the burning charcoal is below its surface, the fire being fed with air through two tubes branching out from each side of the ash pit." The furnace, as improved, is cylindrical, and a semi-cylindrical tube passes down the middle of it, from near the top to the ash pit, through which the air is supplied to the fire.

Claim.—"Having thus fully described the nature of my improvement, and shown the manner in which I carry the same into operation, what I claim therein as constituting my invention, and desire to secure by letters patent, is the giving to the body of the furnace for the heating of baths, a cylindrical form, and placing the tube, or tubes, channel, or channels, through which air is supplied to the fire, within said body, in the manner and for the purpose herein set forth. And it is to be understood that although I have mentioned a cylindrical form only, as given to the furnace body, I do not intend thereby to limit myself to this particular shape, as the body may be made oval, or polygonal, or be otherwise varied in form, whilst the instrument will remain substantially the same."

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21. For a machine for making *Splints for Friction Matches;* Norman T. Winans and Thaddeus Hyatt, city of New York, November 26.

The patentees say—"Our new manufacture of splints, or sticks, for matches, consists in the making them by pressure and condensation from wood first cut into thin sheets in the manner of veneers; which sheets, or veneers, many be about an eighth of an inch in thickness. In proceeding to manufacture our splints we divide these veneers into portions of the proper size for subjecting them to pressure by means of suitable instruments, which will at the same time condense the wood, and cut it into strips, or splints, preparatory to their being

dipped into sulphur, or into any composition with which they are to be tipped."

The machine which they describe consists of two rollers, mounted like flatting mill rollers, fluted longitudinally, between which rollers the veneers are passed and are thereby cut and pressed into splints, but not quite separated. Two dies properly fluted may be substituted for the rollers.

The claim is to the "manufacturing of splints, or sticks, for matches, of wood condensed by mechanical pressure between rollers, or dies, as described."

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22. For an improved mode of *Regulating the action of the Waste Steam in Locomotives,* to increase or decrease the draught; Ross Winans, Baltimore, Maryland, November 26.

(The specification will appear in the next number.)

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23. For a mode of *Tubing for Sinking Wells* in alluvial soils; Ebenezer Rice, Salina, Onondaga county, New York, November 26.

The tubes which are to be sunk in bored wells, as described in the specification, are to be made of bored wood in sections, and united by means of two metal ferules at each joint, one of them on the outside let in so as to be flush with the wood, and the other let into the end of each piece mid-way between this and the inside. The lower section of tubing, or pipe, towards the bottom of the well, is to be made of iron. A follower, also made of iron, in two parts, and provided with two ears, is placed on the top, and by means of chains attached to these ears, the force is applied for sinking the tube.

The claim is to the "method of sinking wells in alluvial soils, and marshy grounds, by means of wooden tubing formed in lengths, connected together by metal bands, or hoops, sunk in the ends, together with a metal band on the outside, and provided with a metal tube at the bottom, and also the follower on the top, constructed and applied in the manner and for the purpose described."

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24. For an improvement in the *Cut off Valves of Steam Engines;* Wm. A. Lighthall, city of Albany, New York, November 26.

(See specification.)

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25. For a machine for *Skeining Silk and other Thread;* George Heritage, Chestertown, Kent county, Maryland, November 26.

This instrument is for winding a number of skeins on the same reel, one after another without stopping, until the whole surface of the reel is covered. In front of the reel there are two bars with pins in them, as far apart as the distance the skeins are intended to be separated. One of these bars moves up and down by being connected at each end with a crank on a shaft immediately under it. The bobbin, or spool, from which the silk is drawn, is placed obliquely, so that at

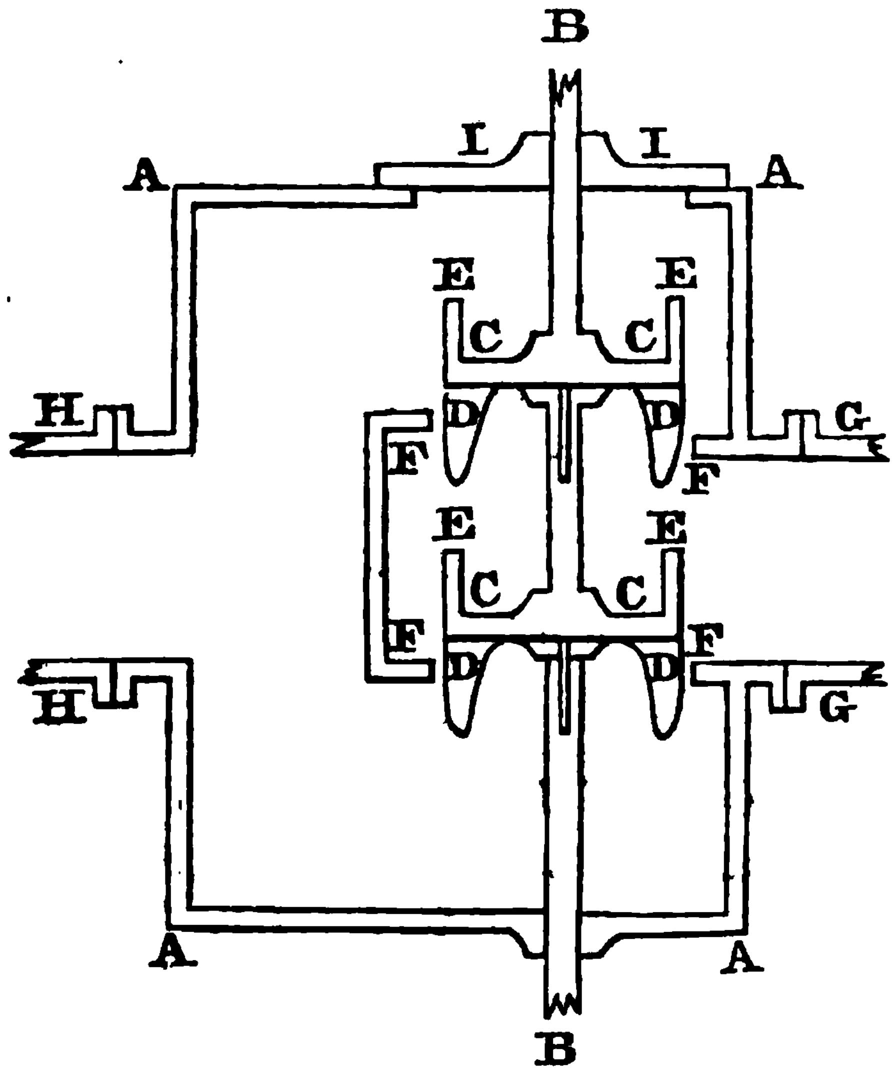
every up and down movement of the bar the silk, or other thread, is shifted one pin, which forms another skein on the reel—at the end of the operation the thread is cut between each skein.

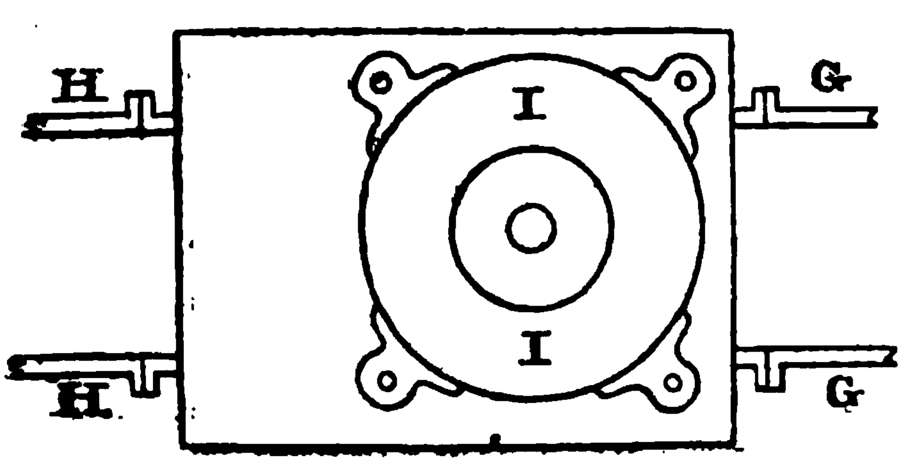
The claim is to the "mode of skeining the silk by the arrangement of the movable and stationary bars and rows of pins in combination with the reel."

Specifications of American Patents.

Specification of a Patent for an Improvement in the Cut-off Valves of Steam Engines. Granted to Wm. A. Lighthall, *city of Albany, New York, November 26th,* 1840.

To all to whom these presents shall come: Be it known that I, the undersigned William A. Lighthall, of the city of Albany and county of Albany, state of New York, have discovered certain improvements in the "half stroke, or cut-off, valve" for steam engines, which I call the "*double plunge half stroke valve,*" and of which the following is a full description.





A, A, A, A, The steam chest; B, B, the valve stems; C, C, the plunge valves of equal diameter, with their rims, or collars, E, E, being three to six inches deep in accordance with the required "throw" and recoil of the valve, thus allowing the valves sufficient play, or motion, while they are in the openings, and still continuing to close them. D, D, four lugs, or guides, upon each valve, having their outer edges gradually tapering inwards towards the stem, or rod, which, together with said stem, or rod, secures the entrance of the valves into F, F, the valves, seats, or openings, which being turned, or bored square instead of beveling or conical, allow the cylindrical formed valves to enter in, and partially through, said openings, and work as

plungers with little or no friction. Thus it will be seen that this valve differs in structure and mode of working from any valves now or heretofore used. The collar part of the valves being cylindrical instead of conical, the lugs, or guides, being sufficiently tapered inwards, and the seat or valve openings being also turned square, or cylindrical, on their edges instead of conical, or beveling, the valves work by plunging into, and partially through, the seat, or opening; the lugs, or guides, are never entirely withdrawn from the openings when lifted, but on the return stroke, or motion, may pass completely through the openings; the collars, or rims, still continuing to close the apertures G, G. The opening to the side pipes, H, H; the opening to the steam pipe I, I. The top view showing the top and bonnet of the steam chest.

The whole apparatus will thus be seen to consist of a cast iron steam chest, or box, A, A, A, A, partially divided by an interior apartment, division, or chest, with apertures F, F, for admitting the steam from the exterior into the interior chest. The valves C, C, play, or work, in those openings, and alternately close and open the communication between the steam apartments. The steam pipe H, H, from the boiler opens into the exterior box, or chest, and the steam pipe G, G, to the cylinder communicates with the interior box, chest, or apartment; when, therefore, the valves are out of the openings the steam is admitted from the exterior chest, or apartment, into the interior, and thence to the side pipes upon the cylinder.

The advantages obtained by my improvements in the cut-off valves as set forth in the specification and drawings herewith submitted, may be thus briefly enumerated.

1st. It shuts off the steam more perfectly than the cut-off valves now in use, and sufficiently perfect for all practical purposes of a half stroke valve.

2nd. It requires less power from the engine to work it, because having two valve plates on one stem of equal superfices it is, when in "situ" in equilibrium floating, as it were, in the steam that surrounds it, the least possible force destroys that equilibrium, and admits the steam. In this respect it is an improvement on the ordinary double balance valve, for that requires the diameter or superfices, of one valve plate larger than the other to keep it in its seat; consequently greater force to displace it, to admit the steam, is necessary.

3rd. It works without noise and consequently obviates the wear and tear from the collision which in the ordinary valves occasion that noise. The conical, or beveled, rims, or edges, of the ordinary double valves strike on their seats and "bring up" with a jar and recoil that soon renders readjustment and repair necessary, and the recoil impairs their effect. If force be applied to counteract recoil, then they "bring up" the harder.

4th. By passing through, instead of on, the seat, these difficulties are obviated—the valve will wear longer without getting out of order, and the collars, or rims, allow it to vibrate (or work up and down) in the openings, still keeping them closed, which is not accomplished in the ordinary half stroke valve.

In the foregoing specification I claim as my invention, or improvement, the combination of two valves working in one stem, constructed as herein described, to wit: with rims, or collars, of sufficient depth to allow the requisite degree of motion while in their seats, and yet continuing to keep the openings closed, and with lugs, or guides, which prevent the valves from being displaced, and at the same time allow the steam to pass freely through the spaces between them.

Wm. A. Lighthall.

Notice of Tatham & Brothers Improved Manufacture of Lead, and other Soft Metal, Pipe.

Two patents have been granted within the last year to Messrs. Tatham & Brothers, of Philadelphia, for manufacturing pipes of lead and of other soft metals; the first of these was granted on the 29th of March, 1841, to John Tatham, Jr., and Henry B. Tatham, as assignees of the inventors of the apparatus used, Messrs. John and Charles Hanson, of Huddersfield, England; the last to George N. Tatham and Benjamin Tatham, Jr., of Philadelphia, for improvements on the foregoing; and this is dated on the 11th of October, 1841. An attempt was made in England, some twenty years ago, to manufacture lead pipes upon the same principle with that adopted in the apparatus of the Messrs. Tatham, and a patent was obtained for it; but the means then adopted for carrying the design into effect were defective, in consequence of which the article produced was imperfect, and the pipe never went into general use.

The usual method of manufacturing lead pipes is by first casting, and then drawing them, upon a suitable sized mandrel, through dies, by the aid of a draw-bench; until the introduction of Hanson and Tatham's machinery, this has been the only process successfully practiced in the United States. Although good pipe was frequently made by this method, it was not by any means uniformly so. It has not been found possible to keep the bore of the pipe in the centre of the mass of metal, and its strength was unavoidably unequal, from this cause. In the operation of casting, the metal sometimes becomes faulty in the interior, and such faults are extended in the act of drawing, and are not shown on the surface. The drawn pipes are usually from ten to sixteen feet only in length, and they have rarely been made of a greater diameter than two inches.

We have not only carefully examined the specification of Mr. Hanson's patent, and of that for the improvements devised by the Messrs. Tatham, but we have also seen, and critically inspected, many of the pipes manufactured by these gentlemen, and so far as a judgment can be formed by these means, the article may be pronounced to be perfect; the bore is truly centrical, the interior and exterior surfaces smooth and polished, the metal compact, and the length indefinite. With respect to their strength, we have conversed with the superintendent of the water works at Richmond, in Virginia, who has these pipes in use under a head of two hundred feet of water, has found them uniformly to bear this pressure, and in all respects

superior to other lead pipes. At the Baltimore water works also, we understand that they have been adopted, and are preferred.

We have delayed noticing the patents for this pipe in the expectation of receiving the report of the committee of the Franklin Institute thereon, which we are informed is altogether approbatory; this report we shall probably publish hereafter;* in the mean time it will be satisfactory to our readers to know something of the nature of the manufacture. The lead, or other soft metal, from which the pipes are to be made, is fused, and poured into a very strong metal cylinder, furnished with a piston, and it is suffered to cool therein sufficiently to become set, or to lose its fluidity. The piston is then forced down by means of a very powerful hydraulic press; by this pressure the metal is made to pass through four openings which surround a mandril, or core, on the outside of the cylinder head, and which is of the size of the intended bore; the four solid bars, or strips of metal, which are formed by these openings, are received within a funnel-formed cavity of steel, which surrounds the core, and by the enormous pressure to which they are subjected they are firmly welded together and made to pass out from a cylindrical opening in the funnel-formed cavity, in the state of a finished tube. The tubes thus made may be cut across into wafer-like pieces, which will exhibit a perfect juncture and continuity of the metal.

We do not attempt to describe the particular construction of the apparatus in its details, as this would require several engraved figures; the specifiations of the original patent, and of that for the improvements, have been drawn up with much care and clearness, and the claims appear to be made to a construction and arrangement of the parts which are new, and, as we believe, sustainable in law.

Progress of Practical & Theoretical Mechanics & Chemistry.

Adcock's Patent Spray Pump.

The following extract from a communication by Mr. Adcock, which appeared in the last number of the *Mining Journal,* fully illustrates the construction and action of his patent Spray Pump, of which we inserted a descriptive notice in a recent number.†

"This wood cut is intended to represent and explain a plan put down by me at the 100-yard shaft, at Pemberton, to relieve the bend pipe and lower part of the apparatus from any water that might, from accidental or other cause, be there collected; and as it answers the intended purpose well, I have no doubt that the wood-cut, and its descriptive account, will be gratifying to many of your readers.

"In the wood-cut *a b c* represent a part of the downcast pipe, or the pipe that conveys the air from the top of the pit, or the galleries and workings of the mine, through the bend pipe into the upcast; *b* to *c* the bend pipe, or that which unites at the bottom of the pit the downcast with the upcast; *c d e* the upcast pipe, or pipe through which the air, and the water commingled with it, is carried to the

* Published at p. 49 of this number. † See Jour. Frank. Inst. vol. ii, 3rd series, p. 380.

surface or top of the pit, that the water may be there again collected in a solid body, and thence be allowed to flow freely away; 6 6 represents five slits, through which the water flows from the sump or well at the bottom of the pit into the upcast pipe, when the apparatus is in action, that it may, by the current of air, be dispersed into drops, like drops of rain, and conveyed to the top. The downcast pipe is twenty-nine and a half inches diameter—the upcast pipe seventeen and a half inches; and when not working, and from causes which it is not necessary to explain, water leaks from the sump into the apparatus, to a height equal to the head of the water there, which is about eight feet from the bottom of the bend, or eight feet seven inches from the bottom of the pipe beneath the bend, consequently, the water rises to the same height in the pipe *g g g g*, which is four inches diameter; *m m* is a pipe, twenty feet long, that receives a supply of water from a water ring, placed so as to receive the water that oozes through and trickles down the sides of the pit. This pipe also is four inches diameter, but is unnecessarily large; it terminates in a compound cone marked *n*, as shown in the figure. Of the smaller cone the dimensions may be thus stated:—Its greater diameter, $\frac{96}{100}$th of an inch; its smaller diameter, $\frac{6}{10}$th ditto; and its length ½ ditto. Of the greater cone, the dimensions may be thus stated:—Its smaller diameter, $\frac{6}{10}$th of an inch; its greater diameter, $1\frac{1}{12}$th ditto; and its length $5\frac{4}{10}$th ditto. A pipe, $\frac{6}{10}$th of an inch diameter, descends from the junction of the larger cone with the smaller into the four inch pipe *g g g g*, as shown by the wood-cut. This pipe is nine feet long.

"Having thus given the proportions, I have only to describe the *rationale* of the contrivance:—The water in the pipe *m m*, is maintained by the water ring, or by the water that oozes through and trickles down the sides of the pit to a height or level equal to the height of the pipe itself, or twenty feet. Now, it is well known that the theoretic velocity of water, flowing out of an aperture, is equal to that of a heavy body falling from the height of the head of water, which is found, very nearly, by multiplying the square root of that height in feet by eight, for the number of feet described in a second. Thus, a head of one foot gives eight, a head of nine feet twenty-four, and a head of twenty feet thirty-five and three-fourths feet per second. This is the theoretical velocity; and from what is equally well known respecting the *vena contracta*, or the contraction which all streams undergo when passing through orifices, we must, in order to obtain the actual velocity, multiply the square

root of the height, in feet, by five instead of eight. It is equally well known, from the experiments of Venturi, Bryan Donkin, and others, that when water flows through a compound cone, as exhibited in the wood-cut, the quantity discharged, and, consequently, its velocity, is even greater than that due to the theoretic velocity. But as the twenty feet pipe, under consideration, terminates in an elbow, just before its junction with the double cone, I am quite willing, in order to prevent dispute, to consider the velocity of the water through the double cone as that due to the contraction of the stream. Hence $\sqrt{20} \times 5 = 22\frac{1}{2}$ feet per second, instead of $35\frac{3}{4}$ feet, as above stated.

I have already had occasion to remark, that the diameter of the suction pipe, nine feet long, which passes from the lower part of the double cone into the pipe, *g g g g*, is $\frac{6}{10}$th of an inch; hence the diameter of that pipe being $\frac{6}{10}$th of an inch, and the velocity of the water flowing over it, at its junction with the cone, twenty-two feet per second, the time occupied, or taken up, by any given particle flowing over its diameter, is $\frac{1}{440}$th part of a second—equal, decimally, to .00227 of a second.

"Now, by the laws of gravitation, the space through which a body will fall in a given time, in feet, is as the square of the time, in seconds, multiplied by $16\frac{1}{12}$. Hence, $.00227^2 \times 16\frac{1}{12} \times 12$ in. $=$ 0001, very nearly, or about a thousandth part of an inch. Hence, by the laws of gravitation, and considering, at the same time, the expansion of the outward cone, from $\frac{6}{10}$ to $1\frac{1}{12}$ inch diameter, and that, too, in a length of $5\frac{4}{10}$th inches, there is not time, in the passage of the water over the orifice of the $\frac{6}{10}$th inch pipe, for any portion of it to fall into that pipe; hence, as the water flows over the orifice of that pipe with rapidity, it, by its friction or adhesion, or the lateral communication of motion in fluids, withdraws from it some portion of the air, and, subsequently, of the water, so as to produce a partial vacuum. The weight of the atmosphere, in the downcast and upcast pipes of the patented apparatus, then comes into play, and forces the water in those pipes continuously from the pipe, *g g g g*, up the $\frac{6}{10}$th inch pipe, and then through the larger cone, until the surface of the water in the bend pipe, *b* to *c*, gets below the level of the nine feet pipe, and, consequently, is below the bottom of the bend. Thus, Mr. Editor, without valves, clacks, pumps, or any thing that can get out of order, is this important object effected.

Henry Adcock, Civil Engineer.

June 21, 1841.

Mechanics' Magazine, July, 1841.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

New Motive Power.—The Force of Trees agitated by the Wind.

The idea of turning to account, as a mechanical force, the oscillations of a tree by the wind, has never been proposed, because no one,

it is probable, has ever deemed it to be a practicable source of power. A very considerable force, the least costly of all, is thus entirely lost. An attempt has been made to bring it into use by Count de Masing and Paulin Desormeaux, and if they have succeeded, as the ingenious apparatus exhibited at the "*Exposition*" would seem to prove, they will have rendered an immense service to the public, and especially to the inhabitants of the country.

The great difficulty which the inventors have to overcome is to convert into a regular rotary and continuous movement the incoherent and vagabond oscillations of currents of wind issuing from all points of the horizon, and often varying with such rapidity as to box the whole compass in the course of five minutes. The movement must necessarily be double, namely, that arising from the wind and the contrary one from the elasticity of the tree. By reducing the question to its simplest expression, in placing the tree in the centre of a triangle we have three points for the motion of the wind, and three others opposite for the motion of elasticity. The authors have sought to economise by reducing to five the number of their organs; in placing the tree in the centre of a pentagon. From whatever quarter the wind comes and the tree rectifies itself, a lever of the third kind is moved, which transmits its motion by a particular mechanism, to an imbedded arbor, which always turns in one direction, and by means of toothed wheels, bands, or otherwise, transmits the motion to the working apparatus. Hence, in whatever way the tree may move, the work is always going on; and it is only in periods of absolute calm that it ceases to act, being in this respect like the sails of a wind mill or a water wheel during a drought.

The King and all his family had this machine explained to them. It is so simple as to cost in the erection but 250 francs. When a convenient tree is wanting, a flexible pole may be erected on a roof, so as to transmit to the interior its motion by the wind, without any of the trouble of adjustment to the wind, reefing, unreefing, or other preparatories requisite in the common machines.

Recueil, Soc. Polytech.

On the Force of Tension of some Condensed Gases. *By* M. Bunsen, (Ann. de Pog.)

I first measured the resistance of the glass tubes to be employed. They were entirely filled with water, a small manometer being previously introduced, and then immersed in water heated gradually to boiling, or 100°. This, from the tendency to expansion of the internal water, represents a pressure of 150 atmospheres. When the tubes burst under such a pressure an infinity of longitudinal and parallel fissures were produced, and a sharp sound was heard.

A tube $11\frac{1}{5}$mm. diameter and $1\frac{1}{8}$mm. thick, burst under a pressure of eighty atmospheres, and I have found tubes of smaller diameter which resisted 200 atmospheres. But in time their tenacity is so diminished that some which had sustained thirty atmospheres have suddenly burst with a pressure of scarcely four atmospheres. I attri-

bute this to a diminution of elasticity like that of other bodies, maintained for some time under strong pressure.

Sulphurous acid, cyanogen and liquid ammonia, subjected to pressure in glass tubes containing a manometer, furnished the following tensions calculated in metres of mercury.

Temperatures.	Sul. Acid.	Cyanogen.	Ammonia.
—33.7°			0.949m
—30.0			
—25.0			
—20.0		0.80	
—15.0		1.10	
—10.0	0.78	1.41	
— 5.0	1.11	1.73	3.64
0	1.48	2.07	3.61
+ 5.	1.91	2.44	4.26
+10.	2.89	2.88	4.98
+15.	2.93	3.33	5.78
+20.	3.54	3.80	6.67
+25.	4.20	"	"

Sulphurous acid boils at 10.5° under a baromatic pressure of 0.744m.

Cyanogen becomes liquid at 25°C., and begins to solidify at 30°, assuming a radiated texture. Its boiling point is 20.7° C.

Ammonial gas should be perfectly dried before being liquified. Its boiling point is 33.7° C.

I have tried in vain to liquify by a reduction of temperature as far as 50°, the gas which results from the combination of hydrogen with Chlorine, bromine, iodine and phosphorus.

We may obtain sulphuretted hydrogen in a liquid state by subjecting hyper sulphuret of hydrogen to decomposition in a tube; but for this purpose the presence of a little water is necessary. If we introduce a few pieces of chloride of calcium in tubes, the hyper sulphuret may be preserved intact while the tube remains hermetically closed.

Ann. des Mines, tome 18, Liv. 2, 1840.

Ductility of Glass.

The conservator of the museum of Avignon has remarked that all the glass vases found buried at Vaison, were so soft and ductile when first discovered that they might be kneaded up and cut with a knife blade, but that they resumed the fragility and hardness of common glass after a few hours exposure to the air. This remark applies only to the vases buried at a depth of at least three metres. Ibid.

Decomposition of Organic Substances, by Barytes. By Pelouze and Millon.

Anhydrous barytes removes from organic substances all the carbonic acid which their elementary composition affords; hydrated barytes carries the destruction farther and tend to burn out the carbon, while the hydrogen which proceeds from the substance unites with that coming from the decomposition of the water and is disengaged in a free state.

Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, FEBRUARY, 1842. COMPUTED BY JOHN DOWNES.*					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
19	13	41	Im. 125 Tauri,	6	93°	
19	14	26	Em.		192	241°
20	5	7	N. App. 792 Baily, 7, ☽ south 2.'0			
29	15	7	Em.		124	
	16	4	Im. A' Scorpii,	5	208	219

* The absence of Mr. Downes on the North Eastern Boundary Exploration prevented the receipt of the announcements for December and January.

Meteorological Observations for November, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	54	72	30.23	30.15	W.	Moderate.		Fog—flying clouds.
	2	54	62	29 86	29 86	W.	do.	.35	Rain—clear.
	3	44	61	.84	.78	W.	do.		Clear—do.
	4	45	42	.60	.60	EW.	do.	.20	Partially cloudy—rain.
☽	5	28	46	.67	.75	W.	Brisk.		Flying clouds—clear.
	6	39	47	.90	30.00	W.	do.		Clear—do.
	7	32	42	30.15	.15	W.	Moderate.	.27	Clear—do.
	8	38	43	.00	29.90	SW.W.	do.		Rain—do.
	9	33	46	.20	30.30	NE.	do.		Clear—do.
	10	34	42	.40	.40	NE.	do.	.26	Cloudy—do.
	11	35	43	.34	.20	N.	do.		Cloudy—clear.
⊗	12	44	54	29.70	29 55	S.	do.		Cloudy—rain.
	13	38	48	.55	.55	W.	Brisk.		Clear—flying clouds.
	14	34	52	.50	.50	S.	Moderate.		Clear—do.
	15	34	43	.41	.48	W.	Brisk.		Flying clouds—cloudy.
	16	34	42	.65	.65	W.	Blustering		Cloudy—clear.
	17	32	46	.75	.70	W.	Moderate.		Clear—do.
	18	36	46	.75	.80	W.	do.		Cloudy—do.
	19	30	32	.85	.75	E.	do.	.93	Cloudy—rain.
	20	30	40	.65	.76	NE.	do.		Cloudy—do.
☾	21	39	45	30.06	30 10	W.	do.		Cloudy—do.
	22	44	46	29.90	29.76	SE.	do.	.63	Drizzle—rain.
	23	46	54	.70	.70	W.	do.		Clear—do.
	24	34	46	.90	.94	W.	do.		Clear—do.
	25	35	39	30.08	.90	SE.E.	do.	.53	Rain—do.
	26	39	48	29.56	56	EW.	do.	.11	Drizzle—cloudy.
	27	32	31	.85	30.00	W.	Brisk.		Cloudy—flying clouds.
☺	28	24	31	30.26	.28	N.	Moderate.		Partially cloudy—cloudy.
	29	23	29	29.96	29.96	NW.W.	do.	.58	Snow—do.
	30	19	30	30.14	30.24	SW.	do.		Clear—do.
	Mean	35.26	43.48	29.85	29.85			3.86	

	Thermometer.		Barometer.	
Maximum height during the month,	72 00	on the 1st.	30.40	on the 10th.
Minimum " "	19.00	" 31st.	29.41	" 15th.
Mean	39.37		29.85	

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FEBRUARY, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. By L. Klein, *Civil Engineer.*

[CONTINUED FROM PAGE 10.]

Railroads in Operation and in Progress.

1. *The Budweis and Lintz Railroad* was the first of this kind executed on the continent. The project for the same was begun in 1822 by the late Chevalier de Gerstner, who after having obtained a charter in 1824, formed a company of stockholders in 1825, and commenced the works soon afterwards; for the want of funds, however, they progressed very slowly, and the whole line of eighty miles in length was not completed until the 1st of August, 1832. This railway, the object of which was to connect the Moldau with the Danube and thereby the North Sea with the Black Sea, had to encounter difficulties of no ordinary kind. In regard to its location, the overcoming of a summit 1500 feet above the Danube, and 1000 feet above the Moldau, without resorting to inclined planes, was a difficult problem, which had been solved by Chevalier de Gerstner, (as far as the road has been constructed by himself,) in a manner which does credit to his skill and talents. The greatest inclination from Budweis to the summit is forty-four feet per mile; the smallest radius of curvature 622 feet, and there would, therefore, exist no difficulty of using this part of the line with locomotive steam power. The other half of the railroad, on the contrary, from the summit to Lintz, located and construct-

ed by another engineer, gives evident proofs, that in its execution the directors and engineers were solely governed by the desire of finishing the work at the smallest possible cost, leaving entirely out of view, so far as grades and curvature are concerned, safety of transit, economy in the management of the road, and all those considerations which are essential to give railways advantages superior to those possessed by common turnpike roads. The grades of this part of the line reach the maximum of 115 feet per mile, and the curves have frequently radii of sixty feet.

If there is anything which can justify such a deviation from the principles which ought to prevail in the location of every railroad, it is the embarrassment in which the company found itself in regard to its finances. Confidence in the success of the undertaking having been lost, and a much larger capital, than originally estimated, become necessary for the completion of the whole railroad, new stock had to be issued, and sold at 25 per cent. of its nominal value, that is 75 per cent. below par(!) The capital thus procured was inadequate to complete the road on the plan on which it was commenced.

The total cost of the railway completed has been only $ 827,150, and as its length is eighty miles, the average cost per mile was $ 10,340, which sum includes also the cost of buildings and outfit. To cover these expenses there were emitted

3783 shares at $ 100 - - - - -	$ 378,300
9000 do. (at $ 100) sold at $ 25 - - -	225,000
400 do. were given as a premium on a loan of -	200,000
Of which $ 6000 is paid back annually.	
1817 shares were finally emitted in 1839, to pay temporary debts and to form an active capital, making in all	
15,000 shares, at the nominal value of - -	1,500,000
Of the loan contracted there is still due - -	140,000
Total, - -	$ 1,640,000

This amount being twice as large as the actual expenditure for the railroad, the result must be a proportionate reduction of the productiveness or dividends to the stockholders.

The cost of this railroad must appear very low, if the heavy works, necessary for its graduation, and the circumstance that it was the first work of the kind on the continent, are taken into consideration. The quantity of earth and rock excavated was 2,800,000 cubic yards; 376,000 cubic yards of dry masonry, and 67,000 cubic yards of masonry laid in mortar, had to be executed. The number of bridges

and culverts is not less than 965. The railroad has a single track, with a clear width of three feet seven and a half inches (three and a half Vienna feet,) the superstructure is composed of cross ties six feet in length, flatted on one side and resting upon a bed of stones; of longitudinal sills eighteen feet in length, six by seven inches square, which are fastened in the cross ties by keys, and serve as supports to the flat bars, of two and a half by a half inch. The bars are only nine feet in length, and as no connecting plates were put below the joints, the square ends of the rails are easily pressed into the timber.

With the exception of the mud sills, the superstructure of the first continental railroad is, therefore, the same as that employed much later on so many of the American railroads, and which is now in Europe generally designated by the name of "American Superstructure."

The Budweis and Lintz railroad is worked by horse power, as originally designed; the whole line is divided into six sections of thirteen and a half miles each, and the horse runs daily twice between one section and the next, performing in this manner regularly twenty-seven miles. The time allowed for a trip from one station to another is two and a half hours for passengers, and half a day for freight, so that it takes three days to take goods from Budweis to Lintz, or back. The load drawn by horses varies according to the grades. A wagon weighing one ton is generally loaded with two and a quarter tons of freight, and on a level or moderate grade one horse takes two such wagons; where the grades become steeper three horses are attached to five wagons, two horses to three wagons, finally two horses to two wagons, and on the grade of 115 feet per mile two horses are required to haul up one loaded car. Horses and drivers (the motive power) are furnished by a contractor, who receives one half of the gross income from passengers and one and seven-eighths cents per ton per mile for freight. The latter price is, from time to time, regulated according to the price of oats at the markets of Budweis and Lintz.

The fare is per passenger per mile in first class cars	1.68	cents.
" " " in second "	1.24	"
The charge for freight is per ton per mile from 2¼ to 5		"

The traffic on the road is exceedingly small, the principal object of the same, the connexion of the German ocean with the Black sea, not having been attained yet, as the Moldau, a principal link in this chain of communication, has not yet been improved from its mouth up to Budweis, and the country itself through which the road passes being rather sterile and little populated. The principal article of transportation is salt, which is imported into Bohemia from Upper Aus-

tria. The number of passengers per year is also very small. The following statement exhibits the traffic and net income of the road from the year 1833 to 1840, inclusively.

Year.	Salt carried.	Merchandize, coal, &c.	Total freight	Wood.	Passengers.	Net proceeds.
	Cwt.	Cwt.	Cwt.	Fathoms (120c.)	Number.	Dollars.
1833	....	....	331,609	2733	....	34,028
1834	....	....	450,444	2654	2,379	37,915
1835	320,212	194,040	514,252	1862¼	3,887	45,188
1836	352,671	190,431	543,102	2124	3,948	45,755
1837	324,251	168,842	493,093	2538	3,887	40,650
1838	345,647	234,813	580,460	2078	5,454	48,869
1839	392,388	301,737	694,125	3721	10,479	45,887
1840	340,568	315,204	655,772	4364	10,784	....

The present traffic of the Budweis and Lintz railroad consists in about 40,000 tons of freight and 10,000 passengers. The annual net income is $ 45,000, or nearly five and a half per cent. of the cost of construction.

II.—*Lintz and Gmunden Railroad.*

In the year 1832, the continuation of the Budweis and Lintz railroad on the south of the Danube to the town of Gmunden, on the Traun lake, in the vicinity of the great salt works, was undertaken by the same company, and the whole line was finished and put into operation in 1836. This railroad has a length of forty-two miles, and is constructed on the same plan and principle as that from Budweis to Lintz. It rises towards Gmunden with a maximum grade of fifty-three feet per mile; at the terminus near Gmunden, however, it descends with an inclination of one to twenty-two. The track is single, and has the same width as on the Budweis and Lintz railroad; the superstructure is likewise the same. A branch of one and a half miles in length goes from near the terminus at Lintz to Litzlau, on the Danube, where salt and other goods, which are to go down the river, are transhipped.

The total cost of construction of the Lintz and Gmunden railroad was only $ 360,000, (for forty-three and a half miles,) being at an average of only $ 8,267 per mile. The capital for this road was pro-

cured by a loan of $ 325,000, at five per cent. interest, redeemable after ten years in total, or from that period in twenty yearly instalments with interest on the amounts due. The holders of this scrip had besides some privileges relating to the profits of the road, for which they were indemnified by 1036 shares of the Budweis and Lintz railroad.

The traffic of this railway is much greater than of that from Budweis to Lintz. It is also worked by horse power, and the same contractor who furnishes the horses and drivers for the latter road, does also the transportation upon the Lintz and Gmunden line. He receives 0.357 cent per passenger per mile, and 1.6 cent per ton per mile; while the passenger fare is only 1.326 cent in the first class cars, and 0.884 cent in the second class, the charge for freight is from two and a half to four cents per ton per mile according to the value of the articles. In the following statement, the traffic and net income of the railroad from its opening to the year 1840 inclusive, is contained:

Year.	Salt carried.	Merchandize, coal, wood, &c.	Total freight.	Number of passengers.	Net proceeds.
	Cwt.	Cwt.	Cwt.		Dollars.
1836	464,492	143,174	607,666	74,759	21,313
1837	569,232	144,809	714,041	77,905	26,180
1838	601,606	157,687	759,293	90,353	26,869
1839	652,218	156,106	808,324	103,713	30,023
1840	637,963	284,368	922,231	113,672	....

	1839.	1840.
The net income from both railroads was	$ 86,012	87.402
And has been applied as follows, viz:		
Interest on $ 325,000 for the Gmunden road,	16,250	16,250
Do. on the debt for the Budweis and Lintz road ($ 152,000, and $ 140,000 respectively,)	7,600	7,300
Ninth and tenth instalments for the extinguishment of this debt, - - -	6,000	6,000
Dividends, $ 3.75 per share on 15,000 shares,	56,250	56,250
Total, - -	$ 86,100	$ 85,800

If we compare the net profit with the cost of construction of both railroads ($ 1,187,150,) we find it equal to 7¼ per cent. in 1829, and 7⅓ per cent. in 1840. As, however, a great number of shares have been emitted far below their par value, and a part of the loan made

for the Budweis and Lintz railroad is to be paid back annually from the proceeds, the dividends are reduced to 3¾ per cent. The price of the shares is now sixty-five dollars, (instead of $ 100.)

In the whole, the results of the first Austrian railroads may be regarded as very satisfactory; and they ought to encourage to other similar undertakings in less mountainous and more populous districts.

III.—*Railroad from Prague to Pilsen.*

Soon after the Lintz and Budweis railroad was commenced, the project of connecting the capital of Bohemia with Pilsen by a railroad, to be used chiefly for the transportation of wood and coal, was conceived, and in 1826 the works were commenced. The length of the projected line was eighty miles, of which, however, only thirty-five and a half miles, from Prague to the extensive forests of Pirglitz, had been finished, when the company was obliged to sell the road in order to pay the debts, contracted for its establishment. It is now owned by Prince Turstenberg, in whose forest the line terminates.

This railroad, intended like that from Budweis to Gmunden for the use of horse power, has a great many curves and steep grades, the smallest radius of the former is 240 feet, the maximum grade seventy-three and one-third feet per mile, or one in seventy-two; besides there is an inclined plane on the terminus of the line at Prague of one in twenty, and another on the other end of the line of one in forty. The highest summit is 731 feet above the station at Prague, and the length of the railroad exceeds by seven miles that of the turnpike road between the same points.

The superstructure was made of cast iron flat bars, three feet in length, one and a half inches wide and one inch thick, which were fastened upon continuous sills of stone by wooden pins. Experience has proved this to be a very bad plan of construction. The rails frequently broke, and the great number of joints was very injurious to the cars. New cast iron rails of the common T pattern, six feet in length, are now employed wherever the old ones require to be exchanged. The width of track is three feet seven and a half inches.

The road, as far as completed, has cost about $ 150,000, and was sold at $ 40,000. It is now used by the proprietor for the transportation of wood from his own forests to the capital, and of some coal, building materials, &c. One horse hauls up four empty wagons (each weighing two-thirds of a ton) and takes down four wagons, each loaded with two tons. Where the ascent is one to forty, one horse can take only one wagon; on this grade oxen are now more generally employed to haul up the loaded cars. On the inclined plane at Prague the cars are attached together, and go down by their own

gravity, checked in their speed by brakes and a pair of iron dragging shoes. The horses travel twenty-one miles per day; forty-eight horses and three pairs of oxen perform, at present, the whole service. The charges for freight are at the rate of 2.8 to 3.2 cent per ton per mile. In 1840 the motive power on this road cost 1.43 cent per ton per mile.

It is a curious fact, that in Europe as well as in America the first railroads were established in mountainous districts, where great elevations were to be overcome. Like the roads above described, the oldest roads in the United States—the Mauch Chunk, Carbondale and Mohawk and Hudson railroads—are remarkable for their steep grades and inclined planes.

[TO BE CONTINUED.]

On the Cost of Hauling Stone by four horse wagons, over the common dirt roads of the country. By ELLWOOD MORRIS, C. E.

The following formulæ—founded upon experimental data—have been found useful by the writer in determining one element of the cost of masonry, when the distance of the work from the quarry is known, and the road between the two, presents no greater difficulties than the ordinary dirt roads of the country usually do.

We are aware that in framing an equation to express mathematically the cost of haulage, the grade and character of the road ought to be precisely fixed in the formulæ, and therefore that the phrase *common country road,* conveys but an indefinite meaning; yet practically the term is pretty well understood, and its purport is in a measure fixed in our formulæ, by the load which is assigned therein to a four horse wagon.

If it be found, by inquiry from residents along the road to be used, that either a greater or a less load than that of the formulæ, can probably be hauled by the prescribed team, it is only necessary to substitute a corrective number, and the equation will still give satisfactory results, as the other elements are invariable, or nearly so, in their application to the dirt roads of the country.

It was ascertained, by experiment, that including the time lost in breathing the horses upon the hills, in applying the drag chain, &c., the wagons traveled at an average rate of $2\frac{2}{10}$ miles lineal, *or* $1\frac{1}{10}$ *miles of trip per hour,* the word *trip* meaning traveling twice over the same distance.

Averaging good and bad weather the wagons hauled at each load as much limestone as (inclusive of waste) made *one perch of twenty-five cubic feet* when laid in the wall; though in good weather a num-

ber of wagons for a length of time, and over an unusually good road, were observed to haul one and one-third perches per load, and in one instance where the road was in fine order, although it was hilly, a team of four horses, *without aid upon the ascents,* hauled thirty-six cubic feet of limestone, at one load, the distance of the haulage being $1\frac{1}{10}$ miles.

To the haulage then, of such materials as compact limestone, or those which may not essentially differ from it in weight, our formulæ as they stand are particularly designed to apply; though by altering the load as before suggested for another purpose, it will be found of useful application to stones of different specific gravity.

The time lost in loading, unloading, waiting at the quarry, and all other lost time per load, was found by a number of trials to average nearly thirty minutes or five-tenths of an hour.

When the full daily wages of hands was $ 1.25, and the quarry crane was wrought by a horse worth seventy-five cents per day, the cost of loading a wagon with a perch of stone, by using a common crane at the quarry, and unloading it by hand at the work, *taken together* averaged twenty-five cents per perch, which is the assumed constant charge for these items per load, which we have embodied in the formulæ.

Notation.

$n.=$ *The number of hours wrought per day* by each wagon, which may, upon an average, be considered as ten hours.

$h.=$ *The haul in miles,* or distance of the quarry from the work.

$d.=$ *The daily wages in cents of a four horse wagon,* including the driver and all other charges per day.

$x.=$ *The number of loads hauled per day* by each wagon, each load of stone being assumed to make *one perch of wall.*

$y.=$ *The cost in cents per perch of wall,* of hauling stone any given distance.

Then the formula to find x, the number of loads hauled per day, will in its first form be,

$$\left(\frac{1}{\frac{h}{1.1}+0.5}\right)n=x$$

Substituting 10 for n, transforming and reducing, we have,

$$\left(\frac{1}{\frac{h}{1.1}+0.5}\right)10=\frac{10}{\frac{h+0.55}{1.1}}=\frac{11}{h+0.55}=x \quad \ldots\ldots\ldots \quad \text{I.}$$

And the formula to find y, the cost of hauling per perch, **will be,**

$$\frac{d+0.25}{x} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{II.}$$

When x is found by the formula I, if it has decimals annexed, the nearest *quarter load* to it must be assumed as the true value of x, and used to find y in formula II, because this is the smallest fraction of a load which can be made available in practice, for as a general rule the wagons will stop at night, either at the quarry or at the work; then by driving a little later upon alternate days, an average half load may sometimes be hauled; for instance, in a certain case which occurs to the mind of the writer, three and a half loads were made one day, three loads the next, three and a half the next, &c., thus averaging per day three and a quarter loads, which is not an uncommon case.

Though the number of experiments, and the variety of the circumstances, from which the foundation data of our formulæ were deduced, have not been as numerous as the writer desired, and therefore, though cases may occur where the equations will need corrective quantities, still as they have been found to correspond in their results with sufficient accuracy to actual practice, in hauling the stone, *for some thousands of perches of masonry*, in a series of cases which came under the notice of the writer, he offers them to professional men as at least a better means of determining the value of this element of the cost of constructions of stone, than the mere judgment unaided by calculation, and as some evidence of this, the following statement of calculated and actual results is offered.

Results of the Formulæ compared with Practice.

1.	2.	3.	4.	5.	6.	7.	8.
No. of work at which experiments were tried.	Length of haul in miles.	Loads of one perch hauled in a day of 10 hours, by formula I.	Nearest quarter load to the results of col. 3.	No. of loads actually hauled per day.	Cost per perch in cts. by formula II, assuming the results of col. 4 to $=x$.	Calculated cost using the actual number of loads hauled per col. 5 for x.	Calculated cost in cts. per perch per mile using the numbers of col. 4 as $=x$.
1	$1\frac{10}{100}$	$6\frac{6}{10}$	$6\frac{1}{2}$	$6\frac{1}{2}$	81	81	73
2	$1\frac{70}{100}$	$4\frac{9}{10}$	5	5	105	105	62
3	$1\frac{76}{100}$	$4\frac{9}{10}$	5	5	105	105	60
4	2	$4\frac{1}{3}$	$4\frac{1}{4}$	$4\frac{1}{4}$	124	124	61
5	$2\frac{80}{100}$	$3\frac{3}{10}$	$3\frac{1}{4}$	$3\frac{1}{4}$	162	162	58
6	$3\frac{15}{100}$	3	3	3	175	175	55
7	$3\frac{29}{100}$	$2\frac{9}{10}$	3	3	175	175	53

From the above table, which supposes a team and its driver to cost five dollars per day, it will be perceived that the shortest haul has the greatest cost *per perch per mile;* we are prepared for this result by the reflection, that the additional number of loads consequent upon a shorter haul, increases the quantity of time lost by the teams per day, diminishes consequently the distance actually traveled, and must therefore augment the cost *per perch per mile.*

Computing by formulæ I and II, the maximum haul which a four horse team, upon an average, will perform in a day of ten hours working time, we find it will be near $10\frac{45}{100}$ miles, or $20\frac{9}{10}$ miles lineal traveled per day; and over this distance of $10\frac{45}{100}$ miles, from the quarry to the work, the wagon would daily transport *one perch of stone, or deliver a load a day,* which, putting the team and driver at five dollars per day, and allowing twenty-five cents per perch for loading and unloading, would cost fifty cents per perch per mile of the maximum daily haul; whilst on the other hand, if the quarry were but a mile from the work, the number of loads delivered per day, would be $7\frac{1}{10}$ (say seven) and the cost per perch per mile of haul, would amount to seventy-five cents nearly, including in every case the expense of loading at the quarry, and also of unloading at the work.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Peter Von Smith's Plan for a Railroad.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the plan for a Railroad, invented by Mr. Peter Von Smith of Washington, D. C., Report:

That they have examined the working model and explanatory drawings prepared by the inventor. The peculiarities of this plan may be briefly stated to consist of

I. The adoption of a single rail, supported by a line of upright posts, and elevated a few feet above the surface of the ground. This rail is to be traversed by cars formed of two boxes, which are suspended from the axles of wheels rolling on the rail, the equilibrium being preserved by keeping the centre of gravity of the boxes below the point of suspension.

II. The use of two tracks, (each track consisting of a single rail) having opposite inclinations, along which the cars descend by virtue

of the force of gravity. In the model exhibited, this was the only power employed for the production and maintenance of motion; though the Committee were informed by the inventor, that each car will be provided with a peculiar arrangement, by means of which an adequate force for the preservation of its momentum may be constantly or occasionally developed. But no explanation was offered of the character of this extra power.

III. The introduction of locks, or vertical lifts, at convenient points along the line of the road, for the purpose of raising the cars from the low level to which they are brought by the descending grade, to the summit of the grade along which they are next to descend. The whole line being thus divided into a succession of vertical lifts, through which the cars are elevated by the direct application of a peculiar power, and of uniform grades, through which they descend by the force of gravity.

IV. The employment of the buoyant property of atmospheric air, confined under water, as the means of lifting the cars from the lower to the higher levels. To produce this effect by the arrangements explained to the Committee, there are required a head of water somewhat greater than the height of the lift of the lock; three or more tanks for the condensation of the air, and another tank, or lock, containing a column of water exceeding, by a few feet, the lift of the lock. A framing of timber is inserted in this vessel, bearing on its summit a rail corresponding with that of the lower railroad, and resting on an inverted receiver, which is placed over the orifices of tubes communicating with a vessel containing the condensed air. The density of the air is that which is due to the head of water at command, unless the machinery to work a condensing pump be added to the arrangement.

The cars descending the railroad are brought to rest on the summit of the timber framing immersed in the tank; and by striking a key as they reach their position, liberate the confined air in the condensor, which is discharged into the receiver until the water displaced is equal to the weight to be raised. The buoyant force of the air lifts the frame supporting the car, to the level of the upper track; when the inclined position of the rail permits the car again to be put in motion, and the movement is continued until it reaches the succeeding lock. In this operation the quantity of water consumed in the condensation of the air, is the same as would be required to lift the car directly without the employment of the air; but it is the opinion of the inventor that though it might frequently be difficult to obtain the requisite head and quantity of water at the points where it would be convenient to establish the locks, the condensed air could always be conveyed by

pipes from considerable distances. The execution of such a road would consequently render long lines of pipes indispensable; and the power of the stream would have to be sufficient to overcome the weight of the car and its framing, and the friction of the air in its passage through the pipes.

It is not deemed at all necessary to notice the various contrivances which the author has devised for the condensation and control of the air, and the discharge of the water when the tanks need replenishing, so as to keep up the operation of the machinery of the station—details which can be much more satisfactorily comprehended by inspecting the very ingenious model shown to the Committee. It is thought preferable to confine their examination to the principal features of the plan, with a view to the expression of an opinion of its merits as a competent substitute for the present system of railroad conveyance.

The single rail is not essential to the particular plan before the Committee; and as a road, in all respects similar, was patented in this country by Col. Sergeant many years since, and in England by a Mr. Palmer more recently, the latter of which has been frequently described by the patentee and other professional writers, the merit of this part of the present plan need not now be particularly discussed. A road with a single rail, though exposed to very obvious and serious objections, may possibly possess advantages which will yet authorize the introduction of the method for certain situations. But these advantages, whatever they be, have not yet been acknowledged; and the invention of Mr. Von Smith must therefore be considered independently of this feature.

This part of the plan being withdrawn from the arrangement proposed, the only peculiarities of the method will consist in the use of two roads in all cases; and the substitution of descending uniform grades, with frequent vertical lifts, in place of the undulations and locomotive power employed on other lines.

The practicability of carrying on the ordinary business of a line by such an arrangement will not be questioned, whatever be the nature of the power employed for the vertical lifts; but at the same time the plan appears to be liable to some formidable objections, which it is essential to notice.

In most cases, in this country, a single track is sufficient for the accommodation of all the trade which the work can command; and of course the expense of constructing and maintaining two lines to perform the duty which could be accomplished by one, must be regarded as a very serious item in the comparison of the two systems.

If the cars be forwarded in trains, the expense of constructing and keeping in repair locks of thirty feet lift, adequate to their simultaneous

elevation, would be very great; and if sent singly, the expense of transportation would be seriously augmented by the necessity of employing an agent to accompany each car.

The consumption of time at the locks incident to the system, would also essentially impair its value; and, in the opinion of the Committee, would probably amount to a sufficient inconvenience to constitute an insuperable obstacle to its adoption.

On ordinary well constructed railroads the progress of the cars would not be depended on, in calm weather, if the grade were less than twenty-one or twenty-two feet per mile. And to give an impulse sufficient to generate the velocity intended to be maintained throughout the grade—say sixteen miles per hour—would require an additional fall, immediately at the lock, of at least nine feet. If the maximum lift of the locks be limited to thirty feet, as is proposed, there would be needed, on level ground, and in calm weather, at least one lock in every mile—and a greater number in ascending grades.

It is true that some few feet of lockage might be saved in reducing the momentum of the car at the end of the grade; but, on the other hand, any such saving would be needed to overcome the occasional resistance from head winds, which has not been allowed for in the above estimate of the number of stations. Indeed, the inclination of the grade, even in calm weather, ought to exceed the amount necessary to overcome the resistance; for, if the momentum were, from any cause, destroyed between the stations, it could not otherwise be communicated to the cars, but by resorting to that reserved power suggested, but not explained, to the Committee.

It should be observed that the inventor proposes to reduce the number of lockages, and consequent delay, by diminishing the resistance at the axles of the cars, through the agency of the friction wheels; and to lessen the cost of construction, by the use of the single rail. But as no particular plan was exhibited to the Committee for obviating the objections to a multiplication of such wheels, they do not feel authorized to anticipate a more successful result on this occasion, than has been experienced in former attempts to apply the same principle to the railroad car; and they are not aware of any facts which would serve as the basis of an estimate of the ultimate expense of the single rail, and justify the expectation of any reduction of cost in consequence of its adoption.

In consideration of the objections enumerated, the Committee cannot recommend the plan submitted to their inspection, as a proper or useful substitute for the railroad and motive power which the public judgment has adopted. And as this conclusion is independent of the

cost of power employed at the stations, they have not regarded it as incumbent on them to enter into any investigation of the comparative merits of condensed air as a lifter, operating by virtue of its buoyant force, and of the immediate application of the power used for the condensation of the air, to the same purpose. This and other subordinate questions are superseded by those radical and essential features of the system, to which they have already adverted. But while they do not regard the plan as suitable for the great purposes subserved by the railroad system, they cannot but commend the mechanical ingenuity displayed in the model exhibited by the inventor.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, May 11th, 1841.

Report on Mr. John Wier's Window Blind.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Window Blind constructed by Mr. John Wier, of the city of New York, Report:

That the window blind submitted to their examination differs from the common blind chiefly in the mode of suspension, which (instead of using pulleys inserted in a mortise, or cut, in the head board) is effected by means of a horizontal roller, as long as the width of the blind, passing across beneath the head board, around which are wound the cords passing through each of the blinds. On one end of this roller is a ratchet wheel with a click, or catch,—so that the blind can be raised to the desired height, and there remains fixed without the trouble of winding the cord around pins in the window frame. If it is desired to lower the blind, a check string attached to the catch is pulled, and the roller, with a reverse motion, allows the blind to descend. By this arrangement several defects and inconveniences in the common blind are entirely removed. The blinds always preserve their proper level, or horizontal position, in being raised or lowered, which is frequently not the case when acted upon in the common mode of suspension by two cords passing over pulleys.

The wearing and chafing of the cords consequent upon friction is also avoided, and the disagreeable creaking noise made in raising and lowering the common blind is not heard in this. The mode of changing the position, or inclination, of the blinds, so as to admit or exclude the light, appears also to be an improvement upon the common method.

In conclusion, the Committee would remark generally that they view Mr. Wier's window blind as a decided improvement upon that

useful and almost indispensable article of household furniture, and they understand that it can be afforded at about the same price as the common blind. Having thus the double advantage of utility and economy, they consider it worthy the attention of upholsterers and housekeepers in general.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, October 14, 1841.

Report on John L. Clarke's Brake for Railroad Cars.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the plan for a Brake for Railroad Cars constructed by John L. Clarke, Esq., of Nashua, New Hampshire, Report:

That they have examined the very neat model of the invention of Mr. Clarke, the peculiarities of which are accurately set forth in his description of its purpose and arrangement—viz: "a simple piece of machinery, the object of which is to apply the momentum of the train at the pleasure of the engine man, to the friction brakes, and thereby arrest the progress of the cars. To effect this, under each car, and in the centre, there is a strong rod, of even length with the buffing beams, and so adjusted in bearings as to move freely a given distance, either way, lengthways of the car. Upon this rod are collars and a double set of progressive levers, or toggles, so arranged that when the rod is moved either way the collars will act upon one of the toggles, and this toggle acting upon another lever the brakes are applied to the wheels. There being a continuous line of rods through the whole train, and the rods being the same length with the buffing beams, it is evident that when the rods are at rest the buffers of the cars will come in contact, and the brakes will not be applied. But the rod under the tender is so adjusted that the engine man, by a lever, can at pleasure throw it back, and thus apply the brakes to the tender. The rear end of the tender rod, of course, throws back the rod on the car behind and applies the brakes on that car, and so on through the train.

This arrangement will, of course, dispense with several brakemen, and in any sudden emergency enables the engine man to stop the whole train, in the shortest possible time by simply moving a lever; for the rod under the tender being first thrown back, and its brakes applied, the cars behind, as they successively come up, apply their own brakes by their own momentum till the whole train is at rest."

It may be added to this description that the rod which operates on

the brakes of the tender is provided with a peculiar catch to enable the engine man first to throw the rod back so that its rear end may protrude beyond the buffers, and that the pressure of the rod of the car immediately behind it may bring the brake of the tender upon the tender wheels until considerable friction is there obtained; and an equal amount of friction at the wheels of the cars by the reaction of the tender rod upon the rods of the cars. The Committee do not doubt the efficiency of this machinery, if well constructed, in checking the progress of the train, and they are disposed to anticipate its successful application on a larger scale with much confidence. But yet there are some questionable points which compel them to reserve their entire approbation, until the efficiency of the contrivance has been tested in practice. The influence of the wear and tear, to which the rods and levers will be exposed, in deranging the machinery and unfitting it for action has yet to be ascertained by experiment; and though the model does seem to promise well in these particulars, they do not think it prudent further to commend the plan until experience has afforded better data than they now possess. On the whole they deem the invention worthy of trial by railroad companies.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, November 11th, 1841.

Report on Mr. Joseph Saxton's Reflecting Pyrometer.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Reflecting Pyrometer, invented by Mr. Joseph Saxton of Philadelphia, Pennsylvania, Report:

That this instrument shows and measures, in a peculiar and advantageous manner, the linear expansion of a metallic or other rod subjected to the influence of heat. The rod rests against a fixed support, at one end; the other end of it presses against a sliding bar which carries an arm attached to one end of a fusee chain of a watch. This chain is wound around an axle carrying a mirror; and the other end of the chain is fastened to a spring, to preserve its tension. Hence as the rod under trial expands, and the sliding bar moves, the axle and mirror revolve; and if a sunbeam, thrown upon this mirror in a proper position, be reflected from it upon a distant wall, the angular motion of the reflected image will be twice that of the axle, and will serve to measure the amount of expansion. As the sun is also in motion, a fixed mirror, near the revolving one, is made to reflect another beam, at first coinciding with the former one: and as the latter

beam moves only with the sun, the angular distance between the two reflected beams, or images, will be twice the angular motion of the axle.

This instrument is especially valuable for the trial of compensating pendulums, as has been proved by Mr. Saxton. For this purpose the pendulum was enclosed in a hollow cylinder, in order that hot or cold water might be used for varying the temperature. The cylinder was supported vertically in a proper wooden frame; and the lower end of the pendulum, passing through a cork tightly closing the lower end of the cylinder, was adjusted to the sliding bar beneath it, which pressed firmly upward against the pendulum, by the action of a spring. By this arrangement the revolving mirror was found always to return to its first position, when slightly moved by the hand; thus showing the delicacy of the mechanism: and the pendulum was considered perfect when a change of its temperature caused no motion of the revolving mirror.

The committee deem this invention of Mr. Saxton's so useful and ingenious, that they recommend the award of a Scott's Legacy Medal and Premium, as a slight recognition of this service in the cause of science and the useful arts.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, November 11, 1841.

Progress of Practical & Theoretical Mechanics & Chemistry.

Calotype.

The following account of some recent improvements in photography, by H. F. Talbot, Esq., was lately read before the Royal Society.

The author had originally intended, in giving an account of his recent experiment in photography, to have entered into numerous details with respect to the phenomena observed; but finding that to follow out this plan would occupy a considerable time, he has thought that it would be best to put the Society, in the first place, in possession of the principal facts, and by so doing perhaps invite new observers into the field during the present favourable season for making experiments. He has, therefore, confined himself at present to a description of the improved photographic method, to which he has given the name of *Calotype*, and reserves for another occasion all remarks on the theory of the process. The following is the method of obtaining the Calotype pictures.

Preparation of the Paper.—Take a sheet of the best writing paper, having a smooth surface and a close and even texture. The water

mark, if any, should be cut off, lest it should injure the appearance of the picture. Dissolve 100 grains of crystalized nitrate of silver in six ounces of distilled water. Wash the paper with this solution, with a soft brush, on one side, and put a mark on that side whereby to know it again. Dry the paper cautiously at a distant fire, or else let it dry spontaneously in a dark room. When dry, or nearly so, dip it into a solution of iodide of potassium containing 500 grains of that salt dissolved in one pint of water, and let it stay two or three minutes in this solution. Then dip it into a vessel of water, dry it lightly with blotting-paper, and finish drying it at a fire, which will not injure it even if held pretty near; or else it may be left to dry spontaneously. All this is best done in the evening by candle light. The paper so far prepared the author calls *iodized paper*, because it has a uniform pale yellow coating of iodide of silver. It is scarcely sensitive to light, but, nevertheless, it ought to be kept in a portfolio or a drawer, until wanted for use. It may be kept for any length of time without spoiling or undergoing any change, if protected from the light. This is the first part of the preparation of Calotype paper, and may be performed at any time. The remaining part is best deferred until shortly before the paper is wanted for use. When that time is arrived, take a sheet of the iodized paper and wash it with a liquid prepared in the following manner:—Dissolve 100 grains of crystalized nitrate of silver in two ounces of distilled water; add to this solution one-sixth of its volume of strong acetic acid. Let this mixture be called A. Make a saturated solution of crystalized gallic acid in cold distilled water. The quantity dissolved is very small. Call this solution B. When a sheet of paper is wanted for use, mix together the liquids A and B in equal volumes, but only mix a small quantity of them at a time, because the mixture does not keep long without spoiling. I shall call this mixture the *gallo-nitrate of silver*. Then take a sheet of iodized paper and wash it over with this gallo-nitrate of silver, with a soft brush, taking care to wash it on the side which has been previously marked. This operation should be performed by candle-light. Let the paper rest half a minute, and then dip it into water. Then dry it lightly with blotting paper, and finally dry it cautiously at a fire, holding it at a considerable distance therefrom. When dry, the paper is fit for use. The author has named the paper thus prepared *calotype paper*, on account of its great utility in obtaining the pictures of objects with the camera obscura. If this paper be kept in a press it will often retain its qualities in perfection for three months or more, being ready for use at any moment; but this is not uniformly the case, and the author therefore recommends that it should be used in a few hours after it has been prepared. If it is used immediately, the last drying may be dispensed with, and the paper may be used moist. Instead of employing a solution of crystalized gallic acid for the liquid B, the tincture of galls diluted with water may be used, but he does not think the results are altogether so satisfactory.

Use of the Paper.—The calotype paper is sensitive to light in an extraordinary degree, which transcends a hundred times, or more, that of any kind of photographic paper hitherto described. This may be

made manifest by the following experiment:—Take a piece of this paper, and having covered half of it, expose the other half to daylight for the space of *one second* in dark cloudy weather in winter. This brief moment suffices to produce a strong impression upon the paper. But the impression is latent and invisible, and its existence would not be suspected by any one who was not forewarned of it by previous experiments. The method of causing the impressions to become visible is extremely simple. It consists in washing the paper once more with the gallo-nitrate of silver prepared in the way above described, and then warming it gently before the fire. In a few seconds the part of the paper upon which the light has acted begins to darken, and finally grows entirely black, while the other part of the paper retains its whiteness. Even a weaker impression than this may be brought out by repeating the wash of gallo-nitrate of silver, and again warming the paper. On the other hand, a stronger impression does not require the warming of the paper, for a wash of the gallo-nitrate suffices to make it visible, without heat, in the course of a minute or two. A very remarkable proof of the sensitiveness of the calotype paper is afforded by the fact stated by the author, that it will take an impression from simple moonlight, not concentrated by a lens. If a leaf is laid upon a sheet of the paper, an image of it may be obtained in this way in from a quarter to half an hour. This paper being possessed of so high a degree of sensitiveness, is therefore well suited to receive images in the camera obscura. If the aperture of the object-lens is one inch, and the focal length fifteen inches, the author finds that *one minute* is amply sufficient in summer to impress a strong image upon the paper of any building upon which the sun is shining. When the aperture amounts to one-third of the focal length, and the object is very white, as a plaster bust, &c., it appears to him that *one second* is sufficient to obtain a pretty good image of it. The images thus received upon the Calotype paper are for the most part invisible impressions. They may be made visible by the process already related, namely, by washing them with the gallo-nitrate of silver, and then warming the paper. When the paper is quite blank, as is generally the case, it is a highly curious and beautiful phenomenon to see the spontaneous commencement of the picture, first tracing out the stronger outlines, and then gradually filling up all the numerous and complicated details. The artist should watch the picture as it developes itself, and when in his judgment it has attained the greatest degree of strength and clearness, he should stop further progress by washing it with the fixing liquid.

The fixing process.—To fix the picture, it should be first washed with water, then lightly dried with blotting paper, and then washed with a solution of bromide of potassium, containing 100 grains of that salt dissolved in eight or ten ounces of water. After a minute or two it should be again dipped in water and then finally dried. The picture is in this manner very strongly fixed, and with this great advantage, that it remains transparent, and that, therefore, there is no difficulty in obtaining a copy from it. The calotype picture is a negative one, in which the lights of nature are represented by shades; but

the copies are positive, having the lights conformable to nature. They also represent the objects in their natural position with respect to right and left. The copies may be made upon Calotype paper in a very short time, the invisible impressions being brought out in the way already described. But the author prefers to make the copies upon photographic paper prepared in the way which he originally described in a memoir read to the Royal Society in February, 1839, and which is made by washing the best writing paper, first with a weak solution of common salt, and next with a solution of nitrate of silver. Although it takes a much longer time to obtain a copy upon this paper, yet, when obtained, the tints appear more harmonious and pleasing to the eye; it requires in general from three minutes to thirty minutes of sunshine, according to circumstances, to obtain a good copy on this sort of photographic paper. The copy should be washed and dried, and the fixing process (which may be deferred to a subsequent day) is the same as that already mentioned. The copies are made by placing the picture upon the photographic paper, with a board below and a sheet of glass above, and pressing the papers into close contact by means of screws or otherwise. After a calotype picture has furnished several copies, it sometimes grows faint, and no more good copies can then be made from it. But these pictures possess the beautiful and extraordinary property of being susceptible of revival. In order to revive them and restore their original appearance, it is only necessary to wash them again by candle-light with gallo-nitrate of silver, and warm them; this causes all the shades of the picture to darken greatly, while the white parts remain unaffected. The shaded parts of the picture thus acquire an opacity which gives a renewed spirit and life to the copies, of which a second series may now be taken, extending often to a very considerable number. In reviving the picture it sometimes happens that various details make their appearance which had not before been seen, having been latent all the time, yet nevertheless not destroyed by their long exposure to sunshine. The author terminates these observations by stating a few experiments calculated to render the mode of action of the sensitive paper more familiar. 1. Wash a piece of the iodized paper with the gallo-nitrate; expose it to daylight for a second or two, and then withdraw it. The paper will soon begin to darken spontaneously, and will grow quite black. 2. The same as before, but let the paper be warmed. The blackening will be more rapid in consequence of the warmth. 3. Put a large drop of the gallo-nitrate on one part of the paper, and moisten another part of it more sparingly, then leave it exposed to a very faint daylight; it will be found that the lesser quantity produces the greater effect in darkening the paper; and in general, it will be seen that the most rapid darkening takes place at the moment when the paper becomes nearly dry; also, if only a portion of the paper is moistened, it will be observed that the edges or boundaries of the moistened part are more acted on by light than any other part of the surface. 4. If the paper, after being moistened with the gallo-nitrate, is washed with water and dried, a slight exposure to daylight no longer suffices to produce so much discoloration; in-

deed it often produces none at all. But by subsequently washing it again with the gallo-nitrate and warming it, the same degree of discoloration is developed as in the other case (experiments 1 and 2.) The dry paper appears, therefore, to be equal, or superior, in sensitiveness to the moist; only with this difference, that it receives a virtual instead of an actual impression from the light, which it requires a subsequent process to develop. Civ. Eng. & Arch. Jour., August, 1841.

Report of a Chemical Examination of twenty-four pieces of Corahs, from Calcutta, many of which were more or less damaged by mildew. By ANDREW URE, M. D., F. R. S., Prof. of Chemistry.

These pieces of silk were put into my hands, for analysis, on the 18th of February, after I had, on the preceding 12th of the month, visited the St. Katharine's Dock Warehouse, in New Street, Bishopsgate Street, for the purpose of inspecting a large package of the Corahs, per Colonist. I was convinced, by this inspection, that, notwithstanding the apparent pains bestowed upon the tin plate and teak wood packing cases, certain fissures existed in them, through which the atmospheric air had found access, and had caused iron-mould spots upon the gummy wrapper, from the rusting or oxidizement of the tinned iron.

I commenced my course of analysis upon some of the pieces which were most damaged, as I thought they were most likely to lead me to an exact appreciation of the cause of the mischief; and I pursued the following general train of researches:—

1. The piece of silk, measuring from six to seven yards, was freely exposed to the air, then weighed, afterwards dried near a fire, and weighed again, in order to determine its hygrometric property, or its quality of becoming damp by absorbing atmospheric vapour. Many of the pieces absorbed, in this way, from one-tenth to one-eighth of their whole weight; that is, from one ounce to one ounce and a half upon thirteen ounces. This fact is very instructive, and shows that the goods had been dressed in the loom, or imbued subsequently with some very deliquescent, pasty matter.

2. I next subjected the piece to the action of distilled water, at a boiling temperature, till the whole glutinous matter was extracted; five pints of water were employed for this purpose, the fifth being used in rinsing out the residuum. The liquid wrung out from the silk was evaporated first over the fire, and towards the end over a steam bath, till it became a dry extract; which, in the damaged pieces, was black, like extract of liquorice, but in the sound pieces was brown. In all cases, the extract so obtained, absorbed moisture with great avidity. The extract was weighed in its driest state, and the weight noted, which shewed the addition made, by the dressing, to the weight of the silk. The piece of silk was occasionally weighed in its cleansed state, when dry, as a check upon the preceding experiment.

3. The dry extract was now subjected to a regular chemical analysis, which was modified according to circumstances, as follows:—100

parts of it were carefully ignited in a platinum capsule; during which a considerable flame and fetid smoke were disengaged. The ashes, or incombustible residuum, were examined by the action of distilled water, filtration, as also by that of acids, and other chemical tests, whereby the constituents of these ashes were ascertained. In the course of the incineration or calcination of the extract from the several samples, I never observed any sparkling or scintillation; whence I observed that no nitre had been used in the dressing of the goods, as some persons suggested.

4. Having, in the course of boiling some of the extract from two of the damaged pieces, in a little distilled water, smelt a urinous odour, I was induced to institute the following minute course of researches, in order to discover whether the urine of man had been introduced into the dressing paste of the silk webs. I digested a certain portion of the said extract in alcohol, sixty per cent. over proof, which is incapable of dissolving the rice water, or other starchy matter, which might be properly applied to the silk in the loom. The alcohol, however, especially when aided by a moderate heat, readily dissolves urea, a substance of a peculiar nature, which is the characteristic constituent of human urine. The alcohol took a yellow tint, and being, after subsidence of the sediment, decanted clear off into a glass retort, and exposed to the gentle heat of a water bath, it distilled over clear into the receiver, and left a residuum in the retort, which possessed the properties of urea. This substance was solid when cold, but melted at a heat of 220° Fahr.; and at a heat of about 245° it decomposed with the production of water and carbonate of ammonia,—the well known products of urea at that temperature. The exhalation of the ammonia was very sensible to the smell, and was made peculiarly manifest by its browning yellow turmeric paper, exposed in a moist state to the fumes, as they issued from the orifice of the glass tube, in which the decomposition was usually effected. I thus obtained perfect evidence that urine had been employed in India in preparing the paste with which a great many of the pieces had been dressed. It is known to every experienced chemist, that one of the most fermentative or putrefactive compositions which can be made, results from the mixture of human urine with starchy or gummy matter, such as rice water; a substance which, by the test of iodine water, these Corahs also contained, as I shewed to the gentlemen present, at my visit to the Bonding Warehouse.

5. On incinerating the extracts of the Corahs, I obtained, in the residuum, a notable quantity of free alkali; which, by the test of chloride of platinum, proved to be potassa. But, as the extract itself was neutral to the tests of litmus and turmeric paper, I was consequently led to infer, that the said extract contained some vegetable acid, probably produced by the fermentation of the weaver's dressing, in the hot climate of Hindostan. I, accordingly, examined the nature of this acid, by distilling a portion of the extract along with some very dilute sulphuric acid, and obtained, in the receiver, a notable quantity of the volatilized acid condensed. This acid might be the acetic (vinegar,) the result of fermentation, or it might be the formic or acid of

ants, the result of the action of sulphuric acid upon starchy matter. To decide this point, I saturated the said distilled acid with magnesia, and obtained on evaporation, the characteristic gummy mass of acetate of magnesia, soluble in alcohol, but none of the crystals of formiate of magnesia, insoluble in alcohol. From the quantity of alkali (potassa) which I obtained from the incineration of the extract of one piece of the damaged silk, and which amounted to six grains at least, I was convinced that wood ashes had been added, in India, to the mixture of sour rice water and urine, which would therefore constitute a compound remarkably hygrometric, and well qualified to keep the warp of the web damp, even in that arid atmosphere, during the time that the Tanty, or weaver, was working upon it. The acetate of potassa, present in the said Corahs, is one of the most deliquescent salts known to the chemist; and, when mixed with fermented urine, forms a most active hygrometric dressing,—one, likewise, which will generate mildew upon woven goods, with the aid of heat and the smallest portion of atmospheric oxygen. By the above mentioned fermentative action, the carbon, which is one of the chemical constitutents of the rice or starchy matter, had been eliminated, so as to occasion the dark stains upon the silk, and the blackness of the extract taken out of it by distilled water.

6. That the dressing applied to the webs is not simply a decoction of rice, becomes very manifest, by comparing the incinerated residuum of rice with the incinerated residuum of the extract of the said Corahs. I find that 100 grains of rice, incinerated in a platinum capsule, leave only about one-fifth of a part, or 1 in 500 of incombustible matter, which is chiefly siliceous sand; whereas, when 100 grains of an average extract of several of these Corahs were similarly incinerated, they left fully seventeen parts of incombustible matter. This consisted chiefly of alumina or earth of clay, with silica, potassa, and a little common or culinary salt. (Has the clay been added, as is done in Manchester, to give apparent substance to the thin silk web?)

From the above elaborate course of experiments, which occupied me almost constantly during a period of four weeks, I was fully warranted to conclude that the damage of said goods had been occasioned by the vile dressing which had been put into them in India; which as I have said, under the influence of heat and air, had caused them to become more or less mildewed, in proportion to their original dampness when packed at Calcutta, or to the accidental ingress of atmospheric air into the cases during the voyage from Calcutta to London.

Having in the preceding report demonstrated, by the clearest processes of chemical research, that the above mildewed Corahs had been damaged by the fermentative decomposition of the dressing paste with which they had been so abundantly impregnated, I would recommend the importers of such goods to cause the whole of the dressing to be washed out of them, and the pieces to be thoroughly dried before being packed up. I believe that clean silk may be kept and transported, even in the most humid atmosphere, without undergoing any change, if it be not imbued with fermentative paste.

Lond. Jour. Arts & Sci., July, 1841.

On the circumstances under which the Explosions of Steam Boilers generally occur, and on the means of preventing them. By DR. SCHAFHAEUTL, of Munich.

In this communication it is assumed, that perhaps not one-tenth of the recorded explosions of steam boilers can be correctly attributed to the over loading of the safety valve, or to the accumulation of too great a quantity of steam in the boiler. The author alludes to the degree of pressure which hollow vessels, even of glass, are capable of sustaining, if the pressure be applied gradually. He found, in repeating the experiments of Cagniard de la Tour, subjecting glass tubes of one or two inches in length, one-fourth part filled with water, hermetically sealed, and immersed in a bath of melted zinc, that they apparently sustained the immense pressure of four hundred atmospheres, without bursting; but if the end of an iron rod was slightly pressed against the extremity of the tube, and the rod caused to vibrate longitudinally by rubbing it with a leather glove covered with resin, the tube was invariably shattered to pieces. Hence he concludes, that something more than the simple excess of pressure of steam in the boiler is necessary to cause an explosion, and that a slight vibratory motion alone, communicated suddenly, or at intervals, to the boiler itself, might cause an explosion. From the circumstance of safety valves having been generally found inefficient, he concludes that a force has operated at the instant it was generated in tearing the bottom or sides of the boiler, before it could act upon the safety valve. From the sudden effect of this force, explosions have been ascribed to the presence of hydrogen, generated by the decomposition of water; but independently of the difficulty of generating a large quantity of hydrogen in such a manner, it could neither burn nor explode without the presence of a certain quantity of free oxygen, or atmospheric air; and such an explosive mixture would not take fire, even if mixed with 0.7 of its own volume of steam. The ordinary mode of converting water into steam is by successively adding small portions of caloric to a relatively large body of liquid; but if the operation was reversed, and all the heat imparted to a given quantity of water in one unit of time, an explosive force would be developed at the same moment. For example, if a bar of iron be heated until it is coated with liquid slag, and is then laid upon a globule of water on an anvil, and struck with a hammer, the liquid slag communicates its caloric instantly to the water, becoming solid at the same time that the water is converted into vapour with a loud report. A similar occurrence may take place in a steam boiler when a quantity of water is thrown into contact with an overheated plate, either by a motion of the vessel, or from a portion of the incrustation formed on the bottom or sides becoming loosened. A sudden opening of the safety valve may, under certain circumstances, prove dangerous, or even any rapid increase of heat which would cause a violent excess of ebullition in the water. An examination is then entered into of the respective powers of water and of steam, to transmit undulatory motion, and of their compressibility.

According to Laplace, the conducting power of steam at our atmosphere and 294.1° Fah. is 1041.34511 feet per second, and that of water 6036.88 feet. The ratio of these different velocities is therefore as 1 : 4.5. In cases of a sudden explosive development of steam, the principal action is directed against the bottom, or the sides, of the boiler, whence spreading itself through the water it is finally transmitted through the steam to the safety valve: a wave created by an explosion, even at the surface of the water, would reach the bottom or the sides of the boiler, four and a half times sooner than it would effect the top of the steam chamber: but if it took place at the bottom, the time for the explosive wave to reach the safety valve would be the sum instead of the difference of both velocities. Although these relative periods of time may be considered as infinitely small, it is contended that there is sufficient delay (counting from the moment at which the plates begin to yield) to cause the rupture of the material, which would otherwise have yielded by its own elasticity had the time been greater, as all communication of motion is dependent only on time. To illustrate the effect of the sudden development of an explosive force upon the plates of a boiler, the author gives the results of a series of experiments made by him upon iron wires, for the purpose of ascertaining the amount of elongation which took place before yielding under the sudden application of a given weight. The result was, that a wire which had resisted a tension of 22 cwt. when gradually applied, broke invariably, without any elongation, when the same force was suddenly applied by a falling body. Similar experiments with railway bars showed that fibrous iron, which supported a gradual tension, broke by the sudden application of the same force; while close-grained iron, which was incapable of resisting the gradual strain, bore perfectly well that of sudden impact. These facts are worthy of consideration in the selection of iron for boiler plates, where the sudden action of the rending force is to be guarded against. The details are then given of a series of experiments, illustrating in an ingenious model, by means of an explosive mixture of chlorate of potassa, the effects of explosions at different heights within a boiler. A careful examination of the circumstances, and the results of his experiments, convinced the author that a simple mechanical arrangement, applicable to all boilers, might be introduced, so as to diminish the danger arising from the sudden development of an explosive force. He proposes to connect with the bottom of the boiler, by means of a pipe, an extra safety valve of a given area, loaded to five-sixths of the absolute cohesive force of the boiler plate. In the event of a sudden development of steam, the first shock would act upon the valve and open it, which would have the effect of depriving the wave generated of its destructive force, and at the same time diminish the violence of the second shock from the top of the boiler, having permitted the escape of a portion of the water from the boiler.

Lond. Athenæum, Sept. 1841.

Improvement in the Manufacture of Iron. Report of the Furnaces and Stoves of the Manufactory of Wasseralfingen, worked by Gas. By R. H. Schoenberg.

When we endeavour to include in one *coup d'œil* the progress that has hitherto been made in the manufacture of iron, we feel great satisfaction in reflecting on the success which this important branch of industry has attained, and the wonderful effects which have resulted from the aid it has received from science since the commencement of the present century. The numerous efforts that have been made by the iron-masters, and the proprietors of iron foundries, to diminish the expenses of manufacture, by economy in the materials, are remarkable; and most particularly the attempts of every description that have been made to economize fuel.

It is with reference to this object that in blast-furnaces, and in refinery stoves, successive trials have been made of charcoal, coke, of charred wood, coal, and even of anthracite and turf; and that a new mode has thus been introduced of removing the difficulties consequent to the manufacture, and of diminishing the expenses which attend its production. Subsequently were introduced, the application of heated air, the application of the flame from the mouth of the chimney of blast-furnaces to various purposes, and an infinity of other valuable inventions.

The most important of all these improvements is, perhaps, the one for which we are indebted to M. de Faber, director of the iron manufactories of Wasseralfingen, in Wurtemberg, who has been successful in his attempts to collect before it issues from the mouth of the chimney, the gas which is generated in blast furnaces, and which forms the flame that thus escapes, and of applying it as a combustible in refinery stoves, and in puddling and reverberatory furnaces.

The application of the flame issuing from the mouth of the chimney to different purposes, such as heating the air to be forced into the blast-furnaces, burning lime, roasting the ore, making coke, heating steam-boilers, &c., has been known for seven or eight years; yet in all these cases it has been found impossible to produce with this flame a temperature exceeding red heat, which has imposed limits to this method of application, whilst the method of M. de Faber is calculated to produce the highest temperature that can be required in making iron.

The principal method by which this process is characterized, is the following manner of burning the gas, with the introduction of atmospheric air forced through bellows, and in the ingenious construction of the stoves and furnaces. The conclusions which have been arrived at after many years of experience may, without exaggeration, be considered wonderful, and the discovery to which we allude has introduced a new era in the manufacture of iron quite as remarkable as that for which practical mechanics is indebted to the steam-engine. At Wasseralfingen there are at the present time three furnaces or stoves, worked only by escaped gas, in active operation. It is to the

blast-furnace from the south, introduced into this establishment, that the requisite quantity of gas is extracted for heating a refining-furnace. The application of this method is very simple, and is effected by introducing a tube to a certain depth into the chimney of the blast-furnace. It seems that by this means there is obtained at most one-sixth or a fifth of the total quantity of gas produced, and which escapes from this furnace, and it is certain that, notwithstanding this subtraction, there is scarcely any preceptible diminution in the flame which issues from the mouth of the chimney.

The refining furnace produces about 175 metrical quintals of fine metal weekly, which is always of a beautifully white colour, like silver. The method of refining in this gas furnace is brought to such a high degree of perfection, that the iron always runs from it, in a great degree, decarburetted, and it is freed from all impurities, and, among others, from phosphorus and sulphur. The waste, which in the English refining-furnaces worked by coke is never less than from nine to ten per cent., when the furnace is in good order, never exceeds from one to two per cent. Neither must the circumstance be forgotten that the cast iron passed through the refining-furnace usually only consists of fragments from the foundry, which, as is known, contain a considerable quantity of sand adhering to them from the moulds. The whole operation is so well regulated, and all is conducted with so much uniformity, that there is little liability to those miscalculations and losses which are only too common in the refining furnaces generally used. The expenses of manual labour are also equally small.

The results of puddling with gas, have not been attended with less satisfactory results. The puddling furnace, which has been constructed at Wasseralfingen, and which is in operation there, uses the same gas as the blast-furnaces of the north. In the chimney of this one, two suction pipes are introduced to a suitable depth; by means of these a sufficient quantity of gas can be collected to keep a puddling furnace and a reverberatory furnace in operation at the same time; but the power of the water wheel which puts the bellows in action not being sufficiently great, these furnaces can only be kept in operation alternately.

The temperature of the gas puddling stove is, according to the nature of the process, even higher than that of a similar kind of furnace supplied with wood, coal, or turf. The flame is clear and transparent, so that the workman is enabled to command at a single glance all the points in which it is most active. The operation when properly conducted proceeds with perfect regularity and uniformity. In each of these operations from 1.75 to 2 metrical quintals* are charged with fine metal previously heated till they are red hot, and in from one hour and three-quarters to two hours the bars are ready to be shingled. The waste of fine metal during this process is so trifling that it has been found on an average not to exceed from one to two per cent. The quality of the produce is excellent. One peculiar char-

* The quintal is about 221 lbs.—Com. Pub.

acteristic of puddling with gas is, that the formation and reduction of the scoriæ goes on at the same time.

The produce of the gas puddling furnace, amounts weekly to about 125 metrical quintals. The operation in the gas reverberatory furnace, presents also, as in the two preceding cases, very remarkable advantages; yet this operation has not been attended with such important results as those obtained in the refining-furnace and puddling stove, for the waste occasioned by the scoriæ in this case is very considerable, since it amounts to from twelve to thirteen per cent., and sometimes to more. The action of the stove is good, and the temperature sufficiently elevated, so that when no accident occurs, as many as 150 metrical quintals can be submitted to the action of the reverberatory furnace weekly.

After what has been observed, it will be seen that the result of the gas stoves and furnaces of Wasseralfingen, may be considered very satisfactory. According to the preceding data, bar-iron of excellent quality can be made with a waste which scarcely exceeds from twelve to fifteen per cent., and without any expense in the consumption of combustible; or, to speak more correctly, by making the application of a combustible which had hitherto remained useless. It is difficult at present to estimate the full extent of the important advantages which would result from using the gases which escape from blast-furnaces, according to the plan adopted by M. Faber; but it appears certain that this plan unexpectedly opens a vast field of improvement to the iron trade, and that it ought to occupy the serious attention of all who are engaged in this manufacture. Let us hope that, if any prejudices still exist, they will be removed by the great progress that has been made; the numerous and well-authenticated proofs of which do not admit of the least uncertainty with respect to an operation, the advantages of which may have hitherto appeared doubtful, because not sanctioned by experience. Mining Jour., September, 1841.

Method of Preventing Oxydation of Iron. By M. F. L. Allamand.

This composition, of a metallic nature, preserves iron and steel from oxydation, by entering into the pores without in any degree affecting their external appearance, or leaving the least blemish, so that steel instruments (including razors,) fire-arms, &c., retain their polish, and are in some degree better fit for use, after having been subjected to the metallic application. Articles either plain or chased appear superior to platina, and retain, after the application, all the hieroglyphic characters, figures, letters, and other engravings, or cuttings, which were there previously.

Composition of the Material.

Pure Malacca Tin, - - - - -	120
Silver filings, - - - -	4
Yellow tincal, - - - - -	12
Purified Bismuth, - - - -	12

Purified Zinc, - - - - -	12
Regulus of Antimony, - - - -	4
Nitre, - - - - - - - -	11
Salt of Persicaria, - - - - -	1

Method of Purifying the Metals.—The tin ought to be melted separately eighteen times. Each melting should remain about twenty minutes exposed to the action of caloric, and the impurities which arise on the surface should be carefully removed; it is thrown afterwards into a ley formed of vine twigs and persicaria (herb) in equal proportions. The bismuth, the regulus of antimony, and the zinc are also melted separately, but they only require it twice, and they are carefully run into an ingot mould, so that all impurities may remain at the bottom of the crucible. The tincal does not require any purification.

Mixture of the different substances.—The tin is the first material that is melted; the silver is afterwards added to it in small quantities, and in a few minutes afterwards the tincal, then the bismuth and the zinc in succession. As soon as it is ascertained by the flame that the alloy is effected, the two kinds of salt are thrown in together, and are left to burn with vigour, and the alloy is stirred with an iron rod; after which it is carefully skimmed and poured into a vessel, to be made use of for the metallic application.

Method of applying the substance.—Before the piece of iron, or steel, is dipped in the recipient which contains the metallic mass already liquified, its surface must be rubbed well with a composition of sal-ammoniac and cream of tartar, in the proportion of five per cent. of tartar to the sal-ammoniac; the iron must then be dipped in the melted alloy, where it must remain only for a few seconds, and till it is perceived to be covered with a certain quantity of the metal. It is next placed in a wooden box of its own size, and in which there has been previously put a small quantity of sal-ammoniac and cream of tartar, in the proportions already indicated. It is again rubbed with a handful of tow, and a small quantity of the powder is put on the surface. In the course of this operation the steel loses it colour, and assumes that of silver. When this is done, it is again plunged into the metallic mass for a few seconds, and when it is taken out it is again lightly rubbed with the tow to remove any superfluous particles. The article being perfectly clean and shining, it is plunged into a basin of cold water, into which there has been poured a bottle of spirits of wine of forty degrees of strength, in the proportion of ½ per cent. After having withdrawn it from the water, the article is rubbed carefully with a linen, then it is rubbed as carefully with some fine sand, that has been moistened, to remove the spots of smoke: it is at last rubbed a second time with dry sand, then with a linen, and finally with a leather. After all these operations, which require great celerity in the execution, the iron will remain impervious to oxygen, and by care it will preserve all its whiteness.—*Inventor's Advocate.*

Civ. Eng. & Arch. Jour. for Oct., 1841.

On a Plan of Disengaging and Reconnecting the Paddle Wheels of Steam Engines. *By* J. Grantham.

There are four cases in which it may be desirable to disconnect the paddle wheels from the steam engine in steam vessels, viz., when the vessel is on a long voyage, and the fuel must be economized as much as possible by using the sails on every favourable opportunity; when the engines are damaged, and, the vessel being close to a lee shore, it is necessary to disengage the engines quickly, to allow the vessel to make sail; when some derangement has taken place, and the engines are allowed to continue to work imperfectly to the end of the voyage, rather than detain the vessel by causing the paddles to drag through the water while the engines are stopped; when, the vessel being at anchor, the action of the swell and tide on the paddle floats, while stationary, causes a great additional strain on the cables, which would be obviated could the wheels play freely. The Admiralty had called attention to the subject, by inviting plans for effecting it. Several had been proposed for disconnecting the paddles, but Mr. Grantham is not aware of any plan having been proposed by which the wheels could be readily reconnected in a heavy sea. The crank pins are usually fixed in the cranks of the intermediate shaft, a little play being allowed in the eye of the crank of the paddle shaft, to prevent the crank pins from breaking when the centres of the three shafts vary from a straight line by the yielding of the vessel. For the purpose of disengaging and reconnecting, a brass box of a rectangular form is inserted in the eye of the crank of the paddle shaft, which can be moved several inches by means of a screw at the back of the crank. The eye of the crank is so made that two of its sides may be cut away, and through these openings the crank pin can pass when the box is drawn back, or the disengaging effected. The brass box has one of its sides, which sustains the crank pin when in gear, cut away one or two inches to assist in reconnecting the engine, which is effected by screwing the box out one or two inches, or just so far that the crank pin can pass the side which has been cut away, and come in contact with the higher side. This is the correct position for reconnecting, which is accomplished by a single turn of the screw.

Ibid.

On the Propulsion of Vessels by the Trapezium Paddle Wheel and Screw.

Mr. G. Rennie gave an account of the various experiments to which he had been led, on the propulsion of vessels by various forms of paddle floats and by the screw. It was generally admitted that the paddle wheel was the best means of propulsion with which engineers were at present acquainted, and various attempts had been made for its improvement. There are several objections to the square or rectangular floats, particularly the shock on entering the water, and the drag against the motion of the wheel on the float quitting the water;

both of which give rise to considerable vibrations. He had been led, in considering the improvement of the paddle wheel, to have recourse to nature; and the form of the foot of the duck had particularly attracted his attention. The web of the duck's foot is shaped so that each part has a relation to the space through which it has to move, that is, to the distance from the centre of motion of the animal's leg. Hence he was led to cut off the angles of the rectangular floats, and he found that the resistance to the wheel through the water was not diminished. Pursuing these observations and experiments, he was led to adopt a float of a trapezium or diamond shape, with its most pointed end downwards. These floats enter the water with their points downwards, and quit it with their points upwards, and then arrive gradually at their full horizontal action, without shocks or vibrations; and after their full horizontal action, quit the water without lifting it, or producing any sensible commotion behind. After a great variety of experiments, he found that a paddle wheel of one half the width and weight, and with trapezium floats, was as effective in propelling a vessel as a wheel of double the width and weight with the ordinary rectangular floats. The Admiralty had permitted him to fit Her Majesty's steam ship *African* with these wheels, and he had perfect confidence in the success of the experiment. Another means of propulsion was the screw, which had been applied with success by Mr. Smith in the *Archimedes*. In examining the wings of birds and the tails of swift fish, he had been particularly struck with the adaptation of shape to the speed of the animals. The contrast between the shape of the tail of the codfish, a slow moving fish, and the tail of the mackarel, a rapid fish, was very remarkable,—the latter going off much more rapidly to a point than the former. From these observations he was led to try a screw with four wings, of a shape somewhat similar to these, but bent into a conical surface, the outline being a logarithmic spiral. He found also that certain portions of these might be cut off without diminishing the effect. With respect to ascertaining the friction of the screw on the water, great difficulty existed; but he would refer to his experiments, published some years ago in the Philosophical Transactions, in which he measured the friction of the water against a body revolving in it, by the time which a given weight took to descend; this body consisted of rings, and he found that the friction or resistance through the water did not increase in proportion to the number of rings.

Ibid.

Supplementary Account of the Use of Auxiliary Steam Power, on board the "Earl of Hardwicke" and the "Vernon" Indiamen. By Samuel Seaward, M. Inst. C. E.

The advantage of the employment of auxiliary steam power, on board large sailing ships, had been shown by the author in a former paper;* it was now further exemplified by the results of the recent voyages of the "Earl of Hardwicke" and the "Vernon."

* See Journal Franklin Institute vol. ii, page 411—3rd series.

Earl of Hardwicke.—This vessel, of 1000 tons burthen, with one engine of thirty horse power, effected the voyage from Portsmouth to Calcutta in 110 days, a much longer time than usual; but still with an advantage of twenty-nine days over the "Scotia," a fine vessel of 800 tons, which sailed one week before the "Hardwicke," and arrived twenty-two days after her. During the voyage, the "Hardwicke" used her engines 364 hours, and was propelled by it 946 knots; an average of nearly three knots per hour: while in a calm, with the ship steady, she made five knots per hour. The total consumption of fuel was ninety tons.

The "Vernon," which sailed one month after the "Hardwicke," made her passage to Calcutta in ninety-seven days; passed the "Scotia," and arrived seven days before her, gaining forty-two days upon her during the voyage. The "Vernon's" consumption of fuel was also ninety tons, but the copy of her log not being arrived, the number of hours during which steam was used, could not be ascertained.

The "India" steam ship, of 800 tons burthen, with engines of 300 horse power, had not arrived at Calcutta, although she had been out 109 days, so that the "Vernon," with only auxiliary steam power, had already gained twelve days upon her.

The comparison between the advantages of these two vessels, in point of expense, is then fully entered into, and shows a saving of £3,733 in favour of the "Vernon," on a single voyage, while she gained at least twelve days upon the "India," in point of time.

Ibid.

Some Inquiries into the Causes of increased Destructability of Modern Copper Sheathing. By Mr. Prideaux.

In May 1840, Mr. Prideaux was applied to by Mr. Owen, of Her Majesty's dock-yard, to analyze some sheet copper from the sheathing of the *Sanspareil,* which had been on thirty years, and was still in good condition. The sample gave about 0.25 per cent. of alloy, chiefly zinc and tin. This contrasted well with a sample rendered unserviceable in a very short time (in only one year,) and in which no quantity of alloy sufficient to weigh had been found; and the two agreed with two recorded analyses of Sir H. Davy and Mr. R. Phillips, the former having detected, in a very good sample of sheathing, about $\frac{1}{400}$ of tin; the latter having found the sheathing of the *Tartar* frigate (almost destroyed in four years, though never out of Sheerness harbour,) the purest copper he had ever analyzed; and further with the reputed inferiority of the recently prepared sheathing of the Royal Navy, which must have been much purified by the repeated fusions it has undergone. The inference adduced was, that the presence of tin and zinc was favourable to the durability of the copper. Mr. Prideaux, however, proceeded with the analyses in other cases. Four were selected, viz:

From the	Copper on	Annual loss.
Minden	17 years	0.45 per cent.
Plover	only 5	11

Linnet copper rapidly destroyed, could not be taken off sound enough to weigh a sheet.

New Sheathing prepared at Her Majesty's mills, Portsmouth.

There was no conformity between the results in these and the former experiments; they did not show any coincidence between the composition of the sheathing and its durability. The next step, therefore, was to examine how far it might be referred to any of the physical properties of the metal. To ascertain this, slips from each sample, all of equal surfaces (4 + 0.5 inch), were immersed each in a pint of sea water: The five vessels being placed side by side, so as to set them all in like conditions. Sea-water being electro-neutral, and acting *slowly* on copper, a little sal-ammoniac was added, to quicken the action without affecting the neutrality. The greatest waste was on the *Sanspareil* copper, which had worn the best of all; the least on that of the *Plover*, one of the worst. Thus, in the laboratory, under parallel circumstances, they do not observe the same order of durability and waste as they had done in use. The cause of comparative waste appears, therefore, to be in part at least, due to *external conditions*, and of these two classes may be noticed: one depending on the connexion with the ship, the other on the circumstances of her employment. Of the first class two suggested themselves—the position on the ship's side, and the nails by which the copper is fastened. The lower part of a ship's copper seems to suffer much less than the upper, so long as she continues in deep water; but when she grounds at low water, if on black mud, this part suffers most from the action of sulphuretted hydrogen, peeling off in blue flakes. The influence of the nails offers rather more chemical interest. They are never of pure copper, and being very numerous, all in contact with the copper sheets, whilst their heads present also a considerable metallic surface to the salt water, they may produce very decided effects, either preservative or destructive, by a slight electro-chemical difference. Mr. Prideaux therefore examined a vessel which they were just then stripping, her copper being worn out in four years. It was found that round some of the nails the copper was quite entire, for an inch or two, though worn ragged in other parts; whilst elsewhere, and sometimes on the same sheet, the copper round other nails was quite gone, though other fragments of the sheet remained. Here some of the nails appeared to have exerted a protective, others a destructive influence. To ascertain the effect of the nails, five slips of new copper from the same sheet, and of the same size, were suspended equidistant, and at the same depth, in a vessel of sea water from the West Indies. The result was, that all the nails, except one (which was from Her Majesty's dockyard,) appeared to act destructively. Here appears to be *one* instance of a protective nail, not enough so to prevent all waste of the copper, which experience has shown not to be desirable; but doubtless the preservative power may be increased to any requisite degree by attending to the composition of the alloy. The copper is alloyed

chiefly with tin; but if the nail is at once hard and flexible the manufacturer is satisfied without examining what other metals are present. If they were always made just so much electro-positive to the copper as to protect the sheathing, so far as compatible with their own durability, they would seem to offer the simplest, most perfect, and most convenient means of electro-chemical protection. The damage to which the copper is subjected is affected by the circumstances of the ship's employment. Sheathing suffers most where most subject to wash and air, for friction is an agent in the waste as well as oxidation. It is also well ascertained that the copper sheathing suffers most in hot climates, which might be expected upon a common chemical principle, that chemical action increases with the temperature; and it became a question whether this effect of heat, as well as its tendency to promote organic production and decomposition, might not form an important element in this destructive agency. Mr. Prideaux therefore obtained water from different parts of the Gulf Stream, with and without the weed, from the Caribbean Sea, and from Falmouth harbour, where the packets moored, the waters of which might possibly be affected by the mine drainings discharged into the river. Whilst these were being collected, Professor Daniell's announcement of large quantities of sulphuretted hydrogen in the waters of the Guinea coast came before the public. To try the action of these different waters five copper slips, of the same dimensions, cut from the same sheet, were suspended in a pint each of the following samples of water:

1. Heart of the Gulf Stream.
2. Do. with the weed.
3. Caribbean Sea.
4. Falmouth harbour.
5. Plymouth Harbour.

After thirteen days they were taken out and reweighed, having been put in all bright, but cleaned, on taking out, only with a brush in soft water, as in the other experiments:—

	1.	2.	3.	4.	5.
Put in 16th, ...	180.26	182.56	190	169.01	176.41
Out 29th, ...	178.45	182.3	189.6	168.55	176.1
Loss in 13 days,	1.81	0.26	0.4	0.46	0.31

No. 1, came out clean and bright, the others with tarnished surfaces, except No. 2, which was blotched and speckled. The Falmouth water presented no indications of being more corrosive than that of Plymouth, and Mr. Prideaux attributed the great difference of waste in these two cases to some unobserved difference of conditions in the experiment. But the excessive action of the Gulf Stream water, he considered too decided to be doubtful. Not only the quantity wasted, but the metallic clearness of the surface, showed a marked distinction. "But to whatever extent the recently increased waste of sheathing may fairly be charged upon the greater velocity, more constant employment, and greater consequent liabilities of weather and climate of our ships, particularly of the commercial classes, as well as

to difference in the nails, I am inclined," said Mr. Prideaux, "to fear the fault is still to be sought in the copper itself. I have it on the authority of Mr. Moore, that the *Quarantine* cutter, generally at anchor in our harbour, was coppered in October 1832, and her copper is now in a very good state. Her last sheathing held good 14 years. The Eddystone tender, which also moors in Catwater, was coppered in July, 1838, and it is now in much worse condition than the *Quarantine*, which has been on six years longer. That the waste on the Eddystone tender is not owing to her work, is evident, from the fact, that the upper part of her sheathing, which suffers the wash and friction, continues sound, whilst from beneath her floor the copper peels off in blue flakes. That this is attributable, in a great degree, to her occasionally grounding upon the black mud, which generates sulphuretted hydrogen and other corrosive matters, is very probable; the other never grounds, and does less work. Yet the difference is too great to be thus satisfactorily accounted for. The one is in good condition for nine years, the other comes to patch before the end of three: both lying the most of their time in the same harbour. On neither was there any distinct indication of protective or destructive influence in the nails." "Meanwhile, as nails must be used, and present a large metallic surface to the salt water, as well as numerous points of contact with the copper, calculated to give great effect to small electro-chemical differences, either in protection or destruction, it would seem that we ought to render them slightly electro-positive to rolled copper, by the addition of zinc, which would not injure their flexibility or enhance their cost. The test, by the galvanometer, would be easily applied (after a little practice) in making up the metal for casting them, if it is of importance to continue the present system of their manufacture."

There is another method of protection, which came out in the course of these investigations; and which is beginning to occupy public attention. It was before noticed, that the upper part of the copper on the Eddystone tender, which bears the wash and friction of the waves, continues sound; whilst the bottom is fast wearing out. This exception, or rather subversion of the usual conditions, is owing to a coat of fish oil, laid on when the copper was new, to keep it bright; and not extended over the parts out of sight. Such a permanent effect could never have been anticipated from an oil which is not drying, and strongly indicates the facility, as well as efficacy, of this mode of protection. A still more striking case presented itself in the vessel which supplied the observations on the apparent influence of the nails. During our examination, we observed the complete preservative effect of some coal tar, which had trickled down over the copper, from the wood-work above. This had crossed the sheets just where most subject to the wash and friction; and whilst the naked metal had been quite worn away, the coal-tarred streaks remained entire, the surface of the copper, on melting off the tar, being as perfect as when fresh from the roll. Hence coal tar seemed to be an efficient preservative; but then recurs the question—will it keep a clean surface, free from organic adhesions and earthy incrustations? To embrace the oppor-

tunity for experiments, the vessel was sheathed with copper on one side and yellow metal on the other; and her fore quarters to her mid-length varnished with coal tar, laid on hot, upon the metal also heated, by fires of chips round the sides. She has now been twelve months at sea; and, according to the last account, the varnished as well as the metallic surfaces, kept quite clean. Ibid.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Blast Furnaces for Iron Smelting. By S. W. Roberts, Civil Engineer. No. 2.

Esther Furnace; on Roaring Creek, in Cattawissa Township, Columbia County, Pennsylvania. Lloyd Thomas, manager and afterwards lessee. Observations first made Nov. 26th, 1839.

Fuel used *charcoal.* Blast heated in pipes at the tunnel head. Stack thirty feet high, lined with slate. Boshes eight feet, and tunnel head sixteen inches, in diameter.

Water in trunk two feet ten inches wide by twelve inches deep, and now flowing at the rate of 350 cubic feet of water per minute. Falls fourteen feet. Breast-wheel, twenty feet in diameter, with buckets three feet three inches long, makes nine revolutions per minute, which is at the rate of nearly nine and a half feet per second. Absolute power of the falling water, nine and a quarter horses, of Watt's steam standard. Probable power usually exerted by the wheel a fraction over five horses.

Two single-acting, wooden, blowing-tubs, each seven feet in diameter and eighteen inches stroke. The two tubs contain 115.45 cubic feet of air, and, making nine strokes per minute, they blow 1039 cubic feet of air per minute. The plan is that of Dotterer's patent blowing apparatus, having a third tub, between and over the others, to act as an air-vessel or regulator.

The blast is heated at the tunnel head, in fourteen cast-iron pipes, of three inches internal diameter, and six feet nine inches high. It is *sometimes* hot enough to melt lead.

Two tuyeres are used. The water-tuyeres are of wrought iron, and the nozzles are two and a half inches in diameter.

Went into blast April 25th, 1839, and up to November 24th had made 1115 tons 13 cwt. of pig-iron; or, on an average, thirty-seven tons per week for seven months. In some weeks forty tons were made. This furnace generally makes good foundry metal. The ore used is the rich, calcareous, ore from Montour's Ridge near Bloomsburg, which is used in a raw state, and yields from forty-five to fifty per cent. of iron.

Revisited the furnace May 19th, 1840, when it was again in blast, and making thirty-four tons of pigs per week. It then took twenty-eight half-charges in twenty-four hours, each half-charge consisting of twenty-four bushels of charcoal, seventy-five lbs. of broken limestone, and 800 pounds of raw ore. The materials consumed in making one

ton of pig-iron, were 138 bushels of charcoal, 432 lbs. of limestone, and two tons and 132 lbs. of ore.

Estimating twenty lbs. of carbon in a bushel of charcoal, and 1000 cubic feet of air blown per minute, will give 107 *cubic feet of air blown per lb. of carbon consumed.*

During the blast of 1840, which continued for ten months, 1300 tons of iron were made.

In 1841, low water and other circumstances caused a falling off, and the amount of iron made was about 900 tons in nine months. At a time when the water-wheel was making eight and a half revolutions per minute, the pressure of the air in the cold-air pipe was tested with a mercurial gauge, and it averaged seven-tenths of a pound per square inch.

Mr. Lloyd Thomas, the lessee and manager of this furnace, unites long experience in his business with practical common sense, and a desire to learn with a willingness to communicate what he knows.

New Photographic Discoveries. *By* M. Daguerre.

Translated for the Journal of the Franklin Institute, by Prof. Jno. F. Frazer.

The author, having isolated and then electrified the iodized plate of silver which he used in his former method, observed that he thus augmented prodigiously the sensibility of the coating which received the impression. It was then, in fact, sufficient in order to create the images, which the mercury afterwards rendered visible, to raise the screen and to let it fall again immediately.

In practice, this plan gave misty and streaked impressions, in consequence of the too great sensibility of the plate. Thus the bottom of the plate was longer exposed to the light than the upper part. And that this was the cause of the ill-success was proved by the fact that when the bottom of the screen was curved, the streaks upon the image were also curved.

The production of photographic images having thus failed, owing to the excess of sensibility of the electrified plate, M. Daguerre tried substances which were but slightly sensitive, no longer isolated the plate, and electrified it while in the focus of the camera but for a single instant, that is by a single spark. This experiment was successful. The material became extremely sensitive at the moment of the passing of the discharge, and the infinitely short duration of the phenomenon, did not prevent the formation of the image in the focus, or its fixture by the old method.

In this second mode of operating, the movements of the screen may be comparatively slow, without appreciable inconvenience.

Bulletin Soc. Indust., July, 1841.

On Explosions in Mines. *By* M. Graham.

Translated for the Journal of the Franklin Institute, by Prof. Jno. Griscom.

After such explosions the air is loaded with an enormous propor-

tion of carbonic acid which prevents prompt assistance to the workmen, while it is evident that the oxygen of the air is not, in a variety of cases, exhausted by the explosion. It is rendered irrespirable, however by five to ten per cent. of carbonic acid.

The best means of neutralizing that acid rapidly is to introduce a mixture, in equal parts, of slacked lime in dry powder, and glauber salts, which absorbs the acid with extreme avidity. A room containing air vitiated by any unwholesome gas whatever, may be entered without danger by causing the air to filter through a cushion an inch thick filled with this mixture placed carefully over the mouth.

Annal des Mines, 1840.

This, if the statement be worthy of reliance, would be an easy and excellent method of venturing safely and promptly to the relief of persons deprived of motion by descending incautiously into wells and vaults charged with foul air. TRANS.

Detection of Arsenic Acid. By M. ELSNER.

Translated for the Journal of the Franklin Institute, by Prof. JNO. GRISCOM.

It is well known that M. Runger discovers free sulphuric acid by covering a porcelain dish with a solution of one part of sugar and thirty parts of water, heating the dish by exposure to steam till it acquires the same heat, and then dropping on it the liquid supposed to contain the free sulphuric acid. A black colour indicates the presence of this acid, because the greater number of other free acids do not decompose the sugar in this manner.

I have found that arsenic acid acts in a peculiar manner, producing on the porcelain coated with sugar a beautiful scarlet red colour. The reaction is sensible with a liquid containing only $\frac{1}{1200}$ of arsenic acid. The action of the arsenic acid produces on the sugar ulmic acid, which brings the former acid to an inferior degree of oxydation.

Ibid.

Note on the Preparation of Sulphate of Iron. By F. BOUDET.

Translated for the Journal of the Franklin Institute, by Prof. JNO. GRISCOM.

Put into an earthen vessel 1000 parts of water, 330 parts of sulphuric acid at 66°, and add by piecemeal 200 parts of filings or turnings of iron; when the effervescence is over, pour the whole into an iron kettle and boil it rapidly until the liquid marks 35° on the pèse sel. Pour this liquid immediately on a filter impregnated with water acidulated with sulphuric acid, and place in an earthen vessel into which has been previously put 12 parts of sulphuric acid diluted with equal parts of water well mixed together. Stir the solution gently, so as to mix it with the acid and leave it to crystalize.

The crystals drained through funnels and dried rapidly, may be preserved a long time in dry, well closed vessels, without alteration; they are of so pale a white as to appear almost colourless when in small pieces.

Ibid.

On the Protection of Iron by Zinc. *By* M. Munkel.

Translated for the Journal of the Franklin Institute, by Prof. Jno. Griscom.

M. de Althaus, director of the salt works of Durrheim, has succeeded in protecting completely the evaporating pans of the works, thirty feet in length, by nailing to them on the outside, bands of zinc; and he observes that it is not necessary that the two metals be nicely polished at the points of contact. This fact, proved by a trial of more than ten years, lends support to the theory of contact. Ibid.

New Theory of the Galvanization of Metals. *By* N. Schonbein.

Translated for the Journal of the Franklin Institute, by Prof. Jno. Griscom.

Iron, zinc, and copper, become oxydized in the air, in water, and in saline solutions, as well when they are united by contact to other metals, or attached to the poles of a pile, or when they are isolated; but if a current can become established, how weak soever it may be, then one of the metals which serves as the negative pole, or, which is the same thing, which receives the hydrogen, is no longer oxydated as before. It follows from this that the protection of copper by iron is due to a chemical decomposition of the water in question, how feeble soever the junction. It results from my experiments:

1. That neither common nor voltaic electricity is capable of modifying the chemical properties of bodies, and that, consequently, the electro-chemical theories of Davy and Berzelius can not be admitted.
2. That the modifications which certain bodies undergo with respect to their chemical properties when subjected to contact, are due to the production of some substance and its deposition on these bodies by the action of the current.
3. That the most certain mode of protecting oxydizable metals against the action of free oxygen dissolved in water, is to place them in a voltaic circuit composed of the metal in question and a more oxydizable one, and the whole in an electrolytic fluid, like water, which contains hydrogen. Ibid.

Prevention of Explosion in Steam-Engine Boilers.

The Gold Isis Medal of the Society for the Encouragement of Arts, &c., was presented to Mr. Robert M'Ewen, Glasgow, for his Double Mercurial Safety-Valve for Steam-Engine Boilers.

There are two evils against which it is especially necessary to provide in the construction of an apparatus for preventing explosions in boilers, viz. the possibility of the steam passage being intentionally closed, for the purpose of obtaining extraordinary pressure; and the failure of the self-action of the apparatus through the accidental derangement of its parts.

Mr. M'Ewen's apparatus consists of a pair of open tubes, the ends of which are immersed in mercury contained in cups connected with the boiler by a pipe. At the junction of this pipe with its branches for the two cups, is a three-way cock, the ports of which are so pro-

portioned to the openings of the branch pipes, that the steam can neither be opened on, nor cut off from, both cups at the same time. The mercury tubes are proportioned in length to the greatest pressure which the boiler will bear with safety; the mercury will therefore be blown out of the acting tube into the dome at the top, whenever the pressure exceeds this limit, and will fall down through the other tube into the empty cup, while the steam blows out through a pipe at the top of the dome.* When the pressure is sufficiently reduced, the cock may be turned, and the cup which was last filled becomes the acting side of the apparatus.

On the 7th of April, a committee of the Society inspected the action of Mr. M'Ewen's mercurial valve, the apparatus having been attached to the boiler at the works of Messrs. Fairbairn and Murray of Mill Wall. The steam was opened on the mercury at a pressure of five pounds to the square inch, and as soon as it attained the pressure corresponding to the length of the tubes, viz. seven pounds, the mercury was blown, without any loss, into the dome and fell into the empty cup, while the steam blew out through the pipe at the top of the dome, and was condensed in a vessel placed to receive it for the purpose of experiment. On examination of the water in this vessel, not a particle of mercury was found in it. This result sufficiently proved the efficiency of the pipe, which is produced to some distance downwards within the dome, as represented in the section fig. 1, for the purpose of preventing the mercury from splashing out with the rush of steam.

As the action of this apparatus depends simply on a *physical* principle, viz. the opposition of the elastic force of steam to the static pressure of mercury, without the intervention of a *mechanical* obstruction of any kind, it cannot fail of acting, so soon as the pressure of steam exceeds the limit corresponding to the length of the tubes. The novelty of the invention is in the employment of a mercurial tube as a safe vent for the steam, these tubes having hitherto been used only as indicators of steam pressure, being long enough to allow the steam to attain a dangerous pressure without relieving it or giving any other notice of the fact than what may be observed by the eye.

Figure 1 represents the whole apparatus in section. A, the pipe connected with the steam boiler; B, the hollow plug of a cock with a side opening at C, through which the steam passes into the area D, and pressing on the mercury causes it to rise in the tube E, till its weight counterbalances the force of the steam; the tube E opens into the chamber and dome F, to which there is free access for the atmosphere through the neck G; if, therefore, the steam should at any time exceed the due pressure which is limited by the length of the tube E, it will drive all the mercury before it up this tube into the chamber F, and will escape through the neck G; in the meantime the mercury will enter the opposite tube H through the small hole I, and flow down into the other vessel J, where it will be ready again to act as a safety-valve as soon as the attendant has turned round

* Mr. M'Ewen intends that an alarm-whistle be placed in this opening, and also that the apparatus serve as a gauge for indicating the variation of pressure, by means of graduated float-rods in the mercury tubes.

the plug B by its handle K, thus cutting off the communication of the steam with the vessel D, and opening it into the vessel J. The construction of both sides of the apparatus being exactly alike, the tube E having an aperture at L to receive the mercury from the chamber F, this operation may be repeated as often as the escape of the steam gives notice of its being necessary. The bottom of the chamber F, though straight from L to I, is curved like a trough in the cross diameter, as shewn by the curve under F, to conduct all the mercury through the hole I or L, whichever may be opposite the acting tube.

For the sake of perspicuity, only one side opening from the plug B has been adverted to. But the plug is always made with three openings, as shewn in fig. 2, at C, M, and N; by which it will be seen that it is impossible to shut more than one of the chambers, D or J, at the same time. The engineer, therefore, has not the power of completely shutting off the steam by means of the cock, nor could a successful attempt be made to effect this by plugging the pipe in the dome, the material of the latter not being of sufficient strength to bear as high a pressure as the boiler.

Trans. of the Soc. of Arts, &c.

Progress of Civil Engineering.

Management and Direction of Railroads.

While every attention and care has been bestowed upon the construction and improvement of railroads and their machinery, but little has been done towards improving and perfecting the system of management of these works, after their completion. That this neglect is unwise in the extreme, is very evident, for the best constructed and most substantial work can be so managed as to become, in a few years, a mere ruin, and as unprofitable to its owners, as if it had never possessed any advantages. That this error has been in a great degree a cause of the unsuccessful operation of many works for which a far different fate had been reasonably anticipated, cannot be denied.

The management of a completed work resolves itself into two departments,—the engineering and the financial. The former of these is the most important, as upon it alone will depend the prosperous condition of the work;—the latter should be managed simply with a view to the proper collection and disbursement of the monies received.

Our object at present is to make a few remarks upon that portion of the management of public works which belongs more properly to the engineering department, and we are the more anxious to do so, as this is a point which, in our opinion, has been sadly overlooked by the direction of railroad companies. No one would think of committing the equipment and sailing of a ship to the supercargo, although the captain is frequently entrusted with the sale and purchase of cargoes, and the reason of this is obvious, for while the science of navigation requires the experience of years, the mercantile knowledge necessary in the purchase and sale of goods, under general directions from owners, is very simple and easily acquired. But in the management of railroads, a very different system prevails,—the supercargo sails the ship, attends to the repairs, and has unlimited control over things of which he has no knowledge, and is not likely to acquire any, unless at the expense of the owners,—or in other words, the management and repair of the road and machinery, are too often placed in the hands of those as ignorant of engineering as a supercargo is of seamanship. It cannot be expected that when a rather complicated system of machinery has been put in operation at great cost, not only of money but of the labor of professional men, that the whole can at once be handed over to persons of entirely different habits and attainments, for their exclusive control, unless at great hazard.

Although many companies have undoubtedly been so fortunate as to secure the services of non-professional persons, highly capable of carrying on the mechanical department, it is yet to be considered whether the influence of a respectable engineer is not calculated to operate to better advantage for the interest of the company, than the mere opinion of an individual generally under the control of one or

two directors. We need no better evidence upon this head than the comparative success of those roads which are under the superintendence of engineers, and those upon which no such arrangement prevails.

The great objection to the employment of resident engineers as general superintendents of railroads, is the expense. Retrenchment and reform are the great words of the day; but that they always mean what they profess to mean, we are by no means willing to admit. It is considered a great master stroke in financiering, particularly on the coming in of a new board, to show how much of the current expense of the road has been, or rather is intended to be, cut off. Great eclat attends this curtailment, while but few think of looking into the accounts to see whether what has so suddenly been taken off at one end, has not been as suddenly put on at the other. There are few items of expense more insidious than wear and tear of machinery, and it is quite possible that with the same amount of receipts, a reasonable profit may remain in one case, or be eaten up in another. Moreover, the condition of a railroad track has an important influence upon the machinery, and a false economy upon the one, may be imperceptibly bringing ruin upon the other—the yearly expenses are shown to be small, and stockholders are annually gratified by a fair detail of monies saved, and by good dividends—but in a short time the whole road and every thing belonging to it are racked to pieces.

Proprietors should recollect that it is the interest of those in power to retain their influence, and they themselves are too apt to look at the present value of the stock—but while this is well enough for dealers in stocks, it is proper that those who look for permanent investments should keep an eye to the preservation of suitable checks upon a speculative spirit. The tendency of the times is so much towards the abuse of power in the hands of corporations or rather of a few individuals in these bodies, that great care should be taken to avoid even the appearance of evil, and no better means can be taken to advance the character of railroads as an investment, (and good roads are already favorites,) than by establishing a check upon the financial direction, which may prove to stockholders that all is fair and above board, and that the condition of their property is not yearly depreciated to swell the amount of their *apparent* profits. To prevent this, proprietors of railway stock in particular, should not be so derelict of their true interests, as not to follow the example of England, in having annual *competent* investigations into their condition and management.

But it is by no means necessary, that the intention to deceive should exist, to produce the same results. Self-deception may prove as fatal as downright fraud; why then trust to those who are most likely to be misled because they are not even supposed to possess the proper information? It is but a poor comfort when money has been lost, to say, that it has happened rather from the ignorance than the dishonesty of those to whom it has been entrusted.

But the expense of employing engineers in such situations has been greatly overrated. When railroads were first introduced, the demand for civil engineers was far greater than the supply, but at present, very many competent and experienced men can be found who would be the means of saving more than the most liberal salary would cost. Moreover, the expense of superintendence alone would hardly be increased by such an arrangement, for the substitution of one responsible and intelligent head for several offices, would in itself, in some cases, at least be the means of saving expense.

This subject is one upon which much more might be said, and to which we hope again to return. The character which the profession will attain when properly united and organized, will have great influence upon the whole railroad system, and to such an organization do we look with the earnest hope that among many other important topics, the present will receive their attention, and much assistance to the cause be derived from the information thus accumulated.

American R. R. Jour. Nov., 1841.

Memoir of the Montrose Suspension Bridge. By J. M. Rendel, M. Inst., C. E.

Previous to the year 1792, the passage of the River Esk at Montrose was effected by common ferry boats; at that period an act of parliament was obtained for the construction of a wooden bridge, with numerous arches, or rather openings formed by beams, supported upon piles, with stone abutments at either end; the action of the tide undermining the piles, and the usual progress of decay causing great expense for repairs, it was decided in the year 1825, to erect a suspension bridge, the iron work of which was contracted for by Captain Samuel Brown, R. N., for the sum of £9,430, and the masonry of the towers for £9,080. The total cost being £18,510, exclusive of the land arches and approaches; those of the old bridge being preserved for the new one.

The dimensions of the new bridge were—

	Feet.
Distance from centre to centre of the towers, - -	432
Deflection of the chain or versed sine of the catenary, -	42
Length of the suspended roadway, - - - -	412
Width of do do - - - - -	26
Height of do do above low water, - -	21
Do of the towers do do - -	68
Base of the towers at the level of the roadway, -	40 by 20
Archways through the towers, - -	16 wide, 24 high

The towers were built of red sandstone ashlar, raised on a base on the same material, carried upon piles.

Construction.—There were two main chains on each side, arranged above each other in parallel curves, twelve inches apart. Each chain was composed of four bars of iron, five inches wide by one inch thick, and ten feet long, united by short plates, and strong wrought iron pins. The roadway was suspended to these chains

by perpendicular rods, one and a quarter inch in diameter, attached at intervals of five feet, alternately to the upper and lower lines of main chains, at the joints, which were arranged so that those of the upper chain should be over the long bars of the lower one; at the lower end of each suspending rod was a stirrup, which received and carried the cast-iron bearers for supporting the roadway.

Upon these bearers was laid and riveted, longitudinally, a flooring of fir planks, three inches thick, and well caulked; upon this a sheathing of fir, one and a quarter inch thick, was placed transversely, and spiked to the lower planks; over all was spread a coating of about one inch thick of fine gravel and sand, cemented with coal tar.

The suspending rods were without joints. The main chains rested upon detached cast iron saddles, built into the masonry of the towers, and passing down at either extremity, were secured behind cast iron plates in masses of masonry, ten feet under ground.

The construction was commenced in September, 1828, and was finished in December, 1829, a period of only sixteen months.

On the 19th of March, 1830, about 700 persons assembled on the bridge to witness a boat race, when one of the main chains gave way, and caused considerable loss of life. The injury was speedily repaired, but a careful survey of the structure was ordered, and it was discovered that the intermediate or long links of the chains bore so unequally upon the saddles as to be bent and partially fractured. Mr. Telford, who was consulted on the subject, proposed the addition of two other main chains placed above the original ones, and having the same curve, so as to increase the sectional area forty inches—thus giving six chains of twenty inches area each, instead of four chains, as originally constructed.

Mr. Telford's decease occurring at that period, the author was instructed to report upon the state of the bridge, and advise such alterations as he judged to be necessary.

After a minute personal inspection he concurred in Mr. Telford's idea of the necessity of increasing the strength of the bridge, but instead of augmenting the number of the chains, he advised the addition of two bars in width to each of those existing, by which means the required strength might be gained. He was led to this by an opinion that, in all cases, it is desirable to have as few chains as possible.

It appears that there had been but little precision in the workmanship of the chains; for on releasing them they immediately became twisted; thus showing that all the links had not a true bearing. On taking them apart many of the traversing pins were found to be bent, and some of them were cut into, evidently by the friction of the links. This was to be rectified, and new saddles of a different principle and stronger form were recommended; also, that those parts of the chains which rested in the saddles should be entirely composed of short plates. Additions to the masses of masonry holding the chains were likewise deemed advisable.

Between the years 1835 and 1838, all the principal works, with many minor improvements, were executed.

In the author's report on the state of the bridge, he noticed what

he deemed defects in the construction of the roadway, but as there was no positive symptoms of failure, it was allowed to remain. He conceived that in the anxiety to obtain a light roadway, mathematicians, and even practical engineers, had overlooked the fact that when lightness induced flexibility, and consequently motion, the force of momentum was brought into action, and its amount defied calculation.

On the 11th of October, 1838, the roadway of the bridge was destroyed by a hurricane, the effect of which upon this structure is the subject of a paper by Colonel Pasley, published in part 3, vol. 3, of the Transactions of the Institution C. E. To that account the author refers for the principal details, only adding, that on inspecting the bridge, he found the chains, the saddles, and the fastenings, or moorings, quite sound; the principal portion of the roadway had been completely carried away, and the remainder much injured. He then gives some account of the undulatory motion observed during the storm. This motion was greatest at about midway between the towers and the centre of the roadway; but the waves of the platform did not coincide with those of the chains, either in magnitude or in order; no oscillatory motion was perceived either in the roadway or in the chains, although particular attention was directed to them.

It appears that the centre of the platform fell in a mass. This the author attributes to the failure of the suspension rods, which, having no joints, were twisted off close to the floor by the undulatory motion. A similar occurrence at the Menai Bridge* induced Mr. Provis to adopt the joints in the suspension rods, which the author had previously introduced at the Montrose Bridge.

The author had long been convinced of the importance of giving to the roadways of suspension bridges the greatest possible amount of stiffness, in such a manner as to distribute the load, or the effect of any violent action, over a considerable extent.

The platforms of large bridges, in exposed situations, are acted upon in so many different ways by the wind, that he had an objection to the use of stays, or braces, to counteract movements which ought rather to be resisted by the form of the structure.

Holding such opinions, he determined to adopt a framing which, although connectedly rigid in every direction, should nevertheless be simple, composed of few parts, capable of being easily renewed, should distribute its weight uniformly over the chains, not be subject to change from variation of temperature, and not augment the usual weight of suspended platforms.

The details of the alterations, and general repair of the bridge, are then given; a few may be mentioned.

An entirely new set of stronger suspending rods was introduced; they were one and five-eighths of an inch in diameter down to the flexible joint at the level of the platform; below that joint the diameter was increased to one and three-fourths of an inch, and a strong thread was cut on to the lower end, so as to adjust them to the requisite lengths.

In the place of the cast iron bearers, cross beams were substituted, composed of two Memel planks, thirteen inches deep, three and a half

* Minutes of proceedings, pages 167 and 204.

inches thick, bolted together, and trussed with a round bar one and one eighth inch diameter; every sixth beam had a deep trussed frame on the under side, so as to give great stiffness. Above and beneath the cross beams, on each side of the carriage way, were bolted two sets of longitudinal timbers, four in each set; they were further united by cast iron boxes, at intervals of ten feet; and the ends were secured to beams of English oak, built into the masonry of the towers. A curb of Memel timber, eleven inches by six inches, was attached to the ends of the cross bearers, and extended the whole length of the platform.

The planking of the footways was composed of narrow battens, two inches thick, laid transversely from the inner longitudinal beam to the outer curb piece with an inclination, or drip, of one and a half inch in five feet.

The carriage way was formed of four thicknesses of Memel plank; the two lower layers, each two inches thick, were placed diagonally with the transverse beams, crossing each other so as to form a reticulated floor, abutted against the longitudinal beams; they were firmly spiked to the beams, and to each other, at all the intersections, and upon them was laid and spiked a longitudinal layer of Memel planking, two inches thick. Over the whole was fixed, transversely, a layer of slit battens, one and a quarter inch thick. Each layer was close jointed and caulked, and the upper one was laid in a mixture of pitch and tar. A composition of fine gravel and sand, cemented with boiled gas tar, was laid over the whole, to the thickness of one inch, forming the road track.

To add to the stiffness afforded by this construction, the author caused to be passed through the spaces between the pairs of longitudinal beams, a series of diagonal truss pieces of Memel timber, six inches square, with their ends stepped into the cast iron boxes, which, at every ten feet, grasp the beams. On the other ends of these diagonal truss pieces, cast iron boxes were fixed, which received the straining pieces, placed three feet six inches above, and the same depth below the roadway; an iron screw bolt, one and a quarter inch diameter, at every ten feet, and a contrivance of wedges in the cast iron boxes, enabled any degree of tension to be given to the framing.

The roadway was thus stiffened by two of the strongest kinds of framing, in parallel lines, dividing the carriage way from the foot paths; it was deemed preferable to disconnect them from the suspending rods, and, by bringing them nearer together, to avoid a twisting or unequal strain. The whole formed a compact mass of braced wood work, the diagonal planking giving the horizontal stiffness, and the two trussed frames insuring the vertical rigidity.

The weight of the new roadway was—	Tons.	Cwt.
Wood work, - - - - -	130	19
Cast and wrought iron about ditto, -	36	6
Wrought iron in the suspending rods, -	20	14
Do. do. fencing, - -	8	18
Gravel concrete, - - - -	30	0
Total, - - - - -	226	17

Or 47.5 lb. per square foot, superficial, for the entire roadway.

The weight of the original roadway was—	Tons.	Cwt.
Wood work, - - - - -	69	0
Cast iron about ditto, - - - - -	92	0
Wrought iron in the suspending rod, -	12	9
Gravel concrete, - - - - -	30	0
Total, - - - - -	203	9

Or 23 tons less than the new roadway.

Cost.—The platform described is 412 feet long, and 27 feet wide; it cost £4026 or about 7s. 3d. per superficial foot.

The works were completed in the summer of 1840; the bridge has borne without injury the gales of the last winter; and the stiffness of the platform has given confidence in its strength to all who have examined it. Civ. Eng. & Arch. Jour., Oct., 1841.

Experiments for determining the position of the Neutral Axis of rectangular Beams of Cast and Wrought Iron and Wood, and also for ascertaining the relative amount of compression and extension at their upper and under surfaces, when subjected to transverse strain. By JOSEPH COLTHIRST.

These experiments were undertaken in consequence of the difference of opinion which has long existed respecting the position of the neutral axis of extension and compression of iron and wood.

First experiment.—Two series of experiments were made to determine this point by cutting through the centre of each of a set of eight girders, each six feet six inches long, five inches deep, and half an inch thick, the first to the depth of half an inch, the second to the depth of one inch, and so on, to the eighth girder, in which only one inch of metal remained unsevered. The spaces cut out were then filled with carefully fitted wrought iron keys, and the girders were broken by the application of weights, in the expectation that these weights would be some indication of the neutral point of each girder. The results were, however, so irregular, that no satisfactory deductions could be drawn from them.

Second experiment.—The next attempt was made in the manner suggested by the late Mr. Tredgold, by drawing two fine lines, two and three-fourths inches apart, on a polished surface, at right angles to a girder, in the middle of its length; it was then subjected to strain, and dimensions were sought to be taken to determine where their divergence and convergence commenced, but the differences were too small to be susceptible of accurate determination, otherwise than by a fine micrometical operation, which at the time the author had not an opportunity of applying. The following plan was therefore adopted:

Third experiment.—In the side of a cast iron girder, six feet six inches long, seven inches deep, and one inch thick, a recess was planed at the centre, three inches wide by a quarter of an inch deep. This was filed up very true, and 14 small bars of wrought iron, with coni-

al ends, were placed in it at regular distances of half an inch apart. These bars were of such lengths as to hold sufficiently tight to carry their own weight, and yet that the slightest touch should detach them. The girder was then subjected to strain. The supports were six feet apart; with a strain equal to 100 pounds, the lower bar fell out; as it was increased, they continued to drop, and with 1500 pounds, all those below the centre had fallen. The strain was then increased to 7000 pounds, but no more bars fell. The centre bar remained exactly as when put in; all those above the centre became firmly fixed, and were evidently under considerable compressive force. The strain was then gradually taken off, and all the bars above the centre fell out, their ends having become compressed by the sides of the recess pressing on them; they were, of course, too short when the girder resumed its former condition, and the recess its previous width. These experiments were repeated several times, with pieces of fine wire and dry lance-wood charred at the ends.

The result in every case showed that the *neutral axis* of extension and compression was certainly situated within $\frac{2}{10}$ of an inch of the centre.

Another experiment was still more decisive. A girder nine feet six inches long, eight inches deep, one inch thick, was cast with two brackets or projections on the side, each nine inches on either side of the centre. A brass tube bar, with circular ends and a sliding adjustment, was fixed between the brackets, which had been filed true. The clear bearing was seven feet six inches; a strain of fifty pounds was sufficient to cause this bar to drop out; and with 250 pounds the whole effect of the previous experiment was produced. The tube, when placed loosely, one inch above the centre, was held fast by a strain of 1000 pounds.

Wrought Iron.—Similar experiments were then made on wrought iron, with precisely the same results, showing that the neutral axis, if not actually situated at the centre, was nearly identical with it.

Wood.—A similar series of experiments, made upon wood beams, gave exactly the same results as regarded the position of the neutral axis.

From all the foregoing experiments, the author concludes that the neutral axis of extension and compression in rectangular beams of cast and wrought iron and wood, is situated at the centre of their depth, when those beams are subjected to transverse strains.

Extension and compression. Cast Iron.—Experiments were also instituted to ascertain the amount of extension and compression of cast and wrought iron and wood.

Upon a bar of cast iron, three inches square, and nine feet long, two strips of thin hoop iron were attached, the one on the upper, and the other on the lower side, each strip being fastened to the bar at one end only, while the other end was left free; any change which occurred in the length of the surface to which it was applied was clearly indicated. The differences were recorded by very fine lines on a polished surface. The strips were seven feet six inches long, and were bound to the whole length of the beam by bands of fine wire,

wound round and enclosing them at every nine inches; the beam was then subjected to strain, and the following results were obtained:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
1000	0.22	...	...
2000	0.45	0.04½	.04½
3000	0.65	0.06	0.06
4000	0.87	0.08	0.08
5000	1.20	0.11	0.12
6000	1.50	0.13	0.14

6240 the beam broke; good iron, showing a good clear fracture.

It will be perceived, that until rather more than two-thirds of the breaking weight was put on, the amounts of extension and compression did not sensibly differ, but between that point and the breaking weight, extension yielded in a higher ratio than compression.

Wrought Iron.—Similar experiments were next made on bars of wrought iron, two and a half inches square; the supports were thirteen feet six inches apart, and the strips of hoop iron were twelve feet long.

Weight. lbs.	Deflection. inches.	Compression. inches.	Extension. inches.	Elasticity. impaired.
500	0.55	0.03	0.03	...
1000	1.55	0.06	0.06	...
1280	1.45	0.07	0.07	0.15
1560	1.85	0.08	0.08	...
1800	2.20	0.09	0.09	...
2000	2.70	0.11	0.11	0.65
2280	4.15	0.18	0.19	2.05

With this weight the beam was permanently bent, and its elasticity nearly destroyed.

These experiments showed that, differing from cast iron, the amounts of extension and compression in wrought iron continue to be equal up to the complete destruction of the elasticity of the beam.

Fir battens.—The amounts of extension and compression in rectangular beams of fir timber, when subjected to transverse strain, were next determined; the manner of proceeding was precisely the same as in the preceding experiments.

A batten, four inches by three inches, with the supports eight feet two inches apart, and with strips seven feet six inches long, when subjected to transverse strain, gave these results:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
500	1.10	0.12	0.12
1000	2.30	0.24	0.24

Results.—From these experiments on the amount of extension and compression of cast iron, measured at the upper and under surfaces of rectangular beams, subjected to transverse strain, the author assumes, that within limits which considerably exceed those of elasticity, and equal to at least two-thirds of the breaking weight, there is no sensible difference between the amounts of compression and extension, and that

as the breaking point is approached, extension yields in a higher ratio than compression, and gives way first.

It would appear certain that up to the point when the elasticity of wrought iron is completely destroyed, and the beam is bent, the amounts of compression and extension continue exactly equal, and it is therefore probable that this equality would continue to the last.

It is clear that the amounts of extension and compression up to three-fourths of the breaking weight do not sensibly differ in fir battens, but that as the ultimate strength of the beam is approached, compression yields in a much higher ratio than extension and may be actually seen to give way first.

He states also, that the amounts of extension and compression are in direct proportion to the strain, within the limits of elasticity and that even after those limits are greatly exceeded, and up to three-fourths of the strength of a beam, they do not sensibly differ.

Ibid

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1841.

With Remarks and Exemplifications by the Editor.

1. For *Forming Dovetailed, or Oblique, Catches, or projections, on plates cast from iron* or other metal; Jordan L. Mott, City of New York, December 1.

The patentee says—"These catches or projections are such as are required and used for holding latches, the retaining of stove feet, dovetailed wedges on railroad chairs, and for a variety of purposes similar in character, and well known to founders. The ordinary mode of forming projections for the catches to latch, or retain in place, the doors, or other parts of stoves, and of forming the dovetailed grooves for receiving and retaining the legs of stoves, and of producing projections on cast articles for numerous other purposes, has been by the use of sand cores, or of movable pieces on the pattern, which pieces are taken from the mould after the removal of the main plate, or piece of casting. Instead of employing these, or similar devices, I make holes through the pattern in the part where such projections are to be formed, or through a plate, or piece of metal, or of wood, which may be laid upon the proper part of the mould after the main pattern has been removed, and through these holes I force a punch, or piece, adapted thereto, which is to be so formed as to make an impression in the sand of the exact form required, by which means said impression will be produced with much greater facility and truth than by any of the methods heretofore used or known."

"I am aware that it is a common practice among founders to form depressions in the sand by pricking through holes made in the patterns for that purpose, so as to produce pins, or shanks, on the casting to be obtained, and I do not therefore claim the so doing as of my in-

vention; but it has never been attempted, as I verily believe, to form catches, dovetailed openings, and other devices of a like character, by means of an apparatus such as I have described. What I claim, therefore, as constituting my invention, and desire to secure by letters patent, is the manner herein described of forming such catches and projections by means of a punch, or piece, properly formed for that purpose, there being corresponding openings through the pattern, or through a plate adapted thereto, as set forth."

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2. For a mode of constructing a *Portable Combined Caldron and Furnace,* adapted to the use of Agriculturists and others concerned in the breeding of stock; Jordan L. Mott, City of New York, December 1.

The patentee says—"The furnace which I use is similar in its general construction to that for which I obtained letters patent dated the 19th day of October, 1838," (a notice of this will be found in vol. xxiv. of this Journal, page 287,) "upon this are elevated side pieces of cast iron which surround the caldron or boiler to be used, these side pieces occupy the place, and perform the office, of the brick work ordinarily used in the setting of caldrons, coppers and boilers, said case standing at such distance from the caldron as to constitute a flue space, through which the heated air from the fire shall pass in its way to the exit pipe." The side pieces which form the case are cast in sections, each occupying one-fourth of the circumference of the caldron; the sections being united by catches on the edges of each. The caldron is cast with a rim which rests on the upper edges of the segments and covers the flue space.

Claim—"What I claim in the above described apparatus as of my invention, and which I desire to secure by letters patent, is the combining of the portable furnace and caldron, or boiler, by elevating the sides of said furnace, and connecting therewith the sectional side pieces which constitute the flue surrounding the caldron, or boiler, the whole being constructed, combined, and operating substantially as described."

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3. For improvements in *Locks and Keys;* William Morrett Williams, Middlesex county, England, December 1.

This is a modification of the well known combination lock. The lower edge of the bolt, which is cut into square notches like a rack, slides in what is called a rack box, through which any given number of notched plates slide at right angles to the bolt, and when the notches in all the plates coincide, the teeth of the rack, on the bolt, pass freely through them; but when any one of the plates is pushed in too far, or not far enough, then the bolt cannot slide. Each plate is acted upon by a separate spring. The key consists of a plate with as many pins projecting out from it as there are sliding plates in the lock, and the length of these pins is so adjusted with reference to the notches in the plates that, when pressed upon the sliding plates, the notches in all of them are made to coincide, and permit the bolt to

side. This arrangement is described as applied to door locks, to padlocks, and to liquor locks.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner in which I have combined the rack on the bolt, the rack box, the sliding pieces, and the respective springs, lever and other parts, so as to be acted upon by means of the key or other instrument for opening and closing the same, the whole being constructed and operating substantially as herein set forth in the application to a padlock. I also claim the application of the same principle or general manner of construction, as herein exemplified, in its application to door locks, and to the securing of cocks or taps for the drawing of liquids, and also to all other objects and purposes to which it can be applied, whilst the principle of construction, and manner of operation, remain substantially the same."

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4. For an apparatus for *Heating Buildings by the circulation of hot water through tubes*; Geo. M. Dexter, Boston, Massachusetts, December 1.

The furnace and the tubes through which the heated water circulates, are arranged in an air chamber, the air within which, when heated, is to be carried off to other apartments, or otherwise employed, as may be desired. The furnace is vertical and surrounded with water except at the door for the supply of fuel. A system of vertical and horizontal tubes communicate with the water chamber of the furnace at top and bottom, by means of which connexion the water is kept in constant circulation.

Claim.—"What I claim as constituting my invention and improvement, is the heating of air in a chamber constructed for that purpose, within which chamber there is a system of tubes, which tubes are heated by causing water to circulate through them in the manner set forth, said water being at a temperature below that of boiling, and being supplied by a heated vessel arranged and operating substantially in the manner described, and the air so heated being conveyed from the said chamber through large trunks, or other openings, into the apartments to be warmed, as made known."

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5. For a *Sled for transporting Blocks of Ice* on rivers and lakes; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

This sled is provided with runners on the top, the surfaces of which are bevelled inwards, thus forming a sharp edge on which the blocks of ice will slide easily, and by which they will be prevented from passing off side ways. The claim is confined to the device of beveling the slides inwards.

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6. For improvements in *Cutters for Cutting Ice* of any thickness, or to any required depth; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

Any desired number of cutters are attached to a beam which is

provided with handles, and to which a horse or horses are attached. These cutters are curved, and their forward edges are grooved; they are made wider on the front than on the back, the front being spread out so as to form cutting edges, by which construction the chips that are cut run up on the front edge of the cutters and are discharged at top through an enlargement made for that purpose.

Claim.—"Having thus described my improvements, I claim as my invention the forming of the chisels of ice cutters, of the curved shape in front and rear, as hereinbefore specified, and likewise grooving the front or curved cutting faces of the chisels, and constructing the same wider than the rear, or with lateral cutting edges, for the purpose of effectually removing chips of ice or other extraneous matters, from the sides of the grooves."

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7. For machinery for *Raising Blocks of Ice from the water* of a pond, lake, or other frozen surface of water, and depositing the same on a sled on which they are removed to the storing houses, &c.; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

This machine consists of an inclined rail way and a gig. The gig is sunk in the water, and on being raised brings up a block of ice which is deposited on the rails, down which it slides to a sled properly situated to receive it.

The claim is to the "raising of blocks of ice from the water and depositing the same on a sled by means of the apparatus denominated the gig, in combination with a rail way, &c."

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8. For improvements in machinery for *Reducing Blocks of Ice to a uniform thickness*, and cutting parallel ridges on the upper surface of the same; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

The patentee says—"The first object of my invention is to reduce the blocks of ice to a uniform thickness, so that they may be easily and completely stowed either in the houses or depots, when first collected in the wagons on which it is transported to the vessels for shipment, or in ice houses abroad for ultimate sale, and in general to facilitate every stowage and removal required in the ice business. The next purpose intended to be effected, is the raising of parallel ridges on the upper surface of the blocks, on which the succeeding layers, when packed in the ice house where first collected may rest, thus keeping the residue of their surface apart and preventing the same from freezing together, which generally takes place owing to the melting of the upper layers of ice, and percolation of the water downwards between the blocks, where it freezes and cements the whole into a mass, thus often rendering it difficult and expensive to remove the blocks in good and fair shapes for such purposes as may be required. Lastly the snow ice which often accumulates on the upper surface of the blocks can be easily removed when the ridges are formed."

The blocks of ice slide on a railway, and each block is taken in

succession by the catches on a forcing reciprocating carriage, and forced against a set of knives which reduce it to the required thickness, and leave the ridges on the surface.

The claim is to the "forming of ridges on the surface of blocks of ice, and reducing the remainder of the blocks to a uniform thickness by means of the shaves and chisels, and a forcing carriage in combination with a railway under the same, the whole being arranged and operating together substantially in the manner and for the purpose specified."

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9. For an improvement in the manner of *Taking Measure of the Human Body for the purpose of Drafting and Cutting Coats;* Thomas E. Tilden, Baltimore, Maryland, December 5.

The patentee says—"My first improvement consists of a simple instrument which I denominate Tilden's Daguerreotype, or transfer ruler; and my second improvement consists in the manner of applying the common tape measure, divided into inches and parts of inches, so as to draft and cut from a point, or points, ascertained by the transfer ruler, which system of measuring I denominate Tilden's Balancing system."

The transfer ruler is simply a straight strip of wood, having a spirit level fixed on the middle, or on any other convenient part, of one of its flat sides, and two sliding arms which project out from said ruler at right angles to its length, and by the use of this, and the ordinary measuring tape, all the required measures are obtained. We are under the necessity of omitting a statement of the manner of using the instrument and the tape, as also the mode of laying out the coat, as it would carry us beyond the limits allotted to us.

Claim.—"What I claim as new and desire to obtain by letters patent, is first, the manner of constructing and using the instrument which I have called the transfer ruler, for obtaining a point on the back of the person to be fitted, which shall be in the same horizontal line with the under part of the arms, and for obtaining two such points where the arms, or shoulders, are of unequal height, from which point, or points, the principal measures, constituting my balancing system, are to be taken. Secondly, the manner of taking what I have called my second shoulder measure by the aid of said point or points; also the manner of taking my third shoulder measure as related to and employing the said point or points; and lastly, I claim the manner in which I take what I have herein called my balance measure, and of using the same in drafting for the purpose of cutting, so as to test and balance the respective measures obtained by the mark, or marks, on the middle of the back."

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10. For *Manufacturing Fair Leather;* James C. Booth, Philadelphia, Pennsylvania, December 5. (See Specification.)

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11. For an improved *Padlock;* Soloman Andrews, Perth Amboy, New Jersey, December 5. (See Specification.)

12. For an improvement in the *Axles and Boxes of Carriage Wheels*; Asa R. Reynolds, Skeneateles, New York, December 5.

The patentee says—"The object of my improvement is to obviate the injury resulting to the shoulders, or end bearings, of the axles and boxes of carriages from the continued jolts or blows, of said end bearings against each other when a carriage is running; and also to provide for the easy repairing of such axles and boxes, when the shoulders are worn, and too great a degree of end play is thereby produced. The first of these difficulties I obviate by the insertion of aspiral, or other spring, within suitable recesses formed in the axle and box, in such a manner as to cause such spring or springs to take off the force of the blow from the end bearings, or shoulders. The second I remedy by the insertion of a steel ring, or ferule, which shall form a shoulder, or bearing, and by the renewal of which, at any time when necessary, the axle and box are rendered as perfect in their end bearings as at first."

"I do hereby declare that I do not claim to have made any improvement in the manner of attaching such axles and boxes to each other, but intend to apply my improvement to them under all their various modifications. I confine and limit my claim, therefore, to the insertion of springs, preferring those of the spiral kind, in such manner as that said springs shall act upon the shoulders or end bearings, of such boxes and axles, and relieve them from the immediate and injurious effect of the blows and jolts to which they are subjected when in use. And in combination with such springs, so applied, I claim the application and use of hardened steel ferules, or rings, to constitute the rubbing parts of the end bearings, as set forth."

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13. For an improvement in *Artificial Teeth*; Daniel Harrington, Philadelphia, Pennsylvania, December 10. To run fourteen years from June 18, 1840.

The improvement claimed under this patent is in the making of the ends of the platina wires, which are imbedded in porcelain or mineral teeth before burning, either in the form of screw or pin heads, or in the form of a staple, instead of in the square or chisel form heretofore practised.

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14. For a mode of *Connecting and Disconnecting Railroad Cars*; James Stimpson, Baltimore, Maryland, December 10.

The object of this improvement is to make the tie which connects the locomotive with the train of cars, and the cars with each other, in such manner that when one of the cars runs off the track it shall be disconnected from the others. The connecting apparatus consists of two springs united at one end by a loop which fits on a pin attached to the truck of one of the cars, the other ends being connected by a "forelock." This forelock is jointed to one of the springs, and catches in a mortise cut in the other. Within a proper distance of this

end of the springs there is a stud attached to each, so that the two overlap each other, and the two pins on the truck of the car with which this end of the tie is to be connected, are embraced between the forelock and the two studs. From the foregoing it will be evident that when the locomotive, or one of the cars, runs off the track, the springs will be spread apart by the two pins, which relieves the fore lock and liberates the tie.

The claim is confined to the combination of the spring jaws, forelock, studs, and the two pins on the car.

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15. For a machine for *Raising Blocks of Ice into Storehouses;* Nathaniel J. Wyeth, Cambridge, Massachusetts, December 10.

The machine described is to be erected over a railway, on which the blocks of ice are deposited from sleds. The blocks of ice are slid on to two rails attached to a frame called a "gig" which works up and down in slides; and where the blocks are to be discharged and to run into the storehouse, there are two receiving bars hung by hinges and sustained by chains, so that when the gig is drawn up, the edges of the blocks of ice lift the receiving bars, to permit said blocks to pass up, the bars then fall back, and catch the block, which slides into the storehouse, the receiving bars being inclined, and connected with four inclined rails, called side and centre pieces.

Claim.—"I claim raising blocks of ice to any required height and depositing the same in a structure by means of a hoisting gig in combination with the receiving bars, and side and centre pieces or rails; and I also claim the combination of the above with the railway which receives the blocks of ice from the sled, the whole being arranged and operating together substantially in the manner described."

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16. For an improvement in *Roofing Houses with Slate, Tile, or Metal;* William Docker, New Orleans, Louisiana, December 10.

This invention is for the purpose of dispensing with double courses of slate, tile, &c., by employing plates of sheet iron, tin, or zinc, japanned or lacquered, and placed under the joints of the slates, tiles, &c., which are laid in hydraulic cement or other water-proof composition. The upper end of the plates of metal are to lap over the lower edge of the preceding course of slates, &c., and the lower ends are nailed to the roof, the cement is laid on, and then the next course of slates, tiles, &c. affixed in place.

Claim.—"What I claim as my invention and desire to secure by letters patent is laying the slates, tile, sheets of metals, &c., constituting the roofing, in hydraulic cement, or other water proof composition, in combination with the intermediate plates, which plates should be covered with paint, varnish, lacquer, &c., in the manner and for the purpose described."

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17. For an improvement in the *Door Latch;* Oliver Ludd, Cherry Valley, Oswego county, New York, December 10.

This patent is obtained for an improvement in the mortise latch.

The latch is jointed to a plug of wood which is let into a hole bored in the edge of the door. The handle, or trigger, instead of having a joint pin is to lift up. It passes through the door and has a handle on each side.

The claim is to the method of fastening the latch; and the method of keeping the handle in place. The latter improvement could not be clearly understood without drawings.

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18. For an improvement in the method of *Fastening Buttons on Clothes;* Stephen Clapp, assignee of H. W. Hewet, New York city, December 10.

The claim will give a sufficiently clear idea of this invention, and therefore we will omit any explanation, viz:

"I do not claim to be the inventor of attaching buttons to clothes, &c. by means of a metal flanch having a stem passing through the button, as this has been patented, but what I do claim as my invention and desire to secure by letters patent is the method of uniting the button and flanch by means of a male and female screw, which are prevented from unscrewing by having a thread or pin of wood passed through them as described."

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19. For a machine for *Rolling Puddle Balls*, in the manufacture of iron; Henry Burden, city of Troy, New York, December 10.

The following claim will afford a general view of the nature of this invention, viz:

"What I claim as constituting my invention and desire to secure by letters patent, is the preparing of puddle balls, as they are delivered from the puddling furnace, or of other similar masses of iron, by causing them to pass between a revolving cylinder and a curved segmental trough adapted thereto, constructed and operating substantially in the manner of that herein described, or by causing the said balls to pass between vibrating or reciprocating tables, surfaces, or plates of iron in the manner described, or between vibrating or reciprocating curved surfaces, operating upon the same principle and producing a like result by analogous means."

A patent for this invention was obtained in England, in the name of Gerard Ralston, and an abstract of the specification is given at p. 31, vol. 1, of the present series.

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20. For a method of *Removing Straw from Thrashing Machines;* James Cummings, Cecil, Pennsylvania, December 10.

The straw is discharged from the thrasher on to a concave of slats, over which a wheel of rakes revolves; the teeth catch the straw, and throw it on to an endless belt of slats, and, as the straw is raked off, the grain falls through between the slats.

The claim is to the "mode of conveying the straw from the thrasher by means of a wheel of rakes placed over a concave rack, by raking the straw over it, at the same time permitting the grain to pass through the interstices of the rack."

21. For improvements in the *Spark Arrester;* William P. McConnell, Washington, District of Columbia, December 10.

The smoke and sparks are to be drawn into a rotary fan blower, placed in the smoke-box, by which they are forced up a pipe, and then thrown into a reservoir of water placed above the smoke-box; the smoke and gases pass up through the openings of a perforated plate and out of the chimney, the draught of which is to be increased by the steam from the exhaust pipes. The water reservoir is provided with two pipes and cocks for discharging the water and cinders when desired, and it is also surrounded with a case of larger diameter, leaving a space between the two, and from this space tubes descend, so that the water and extinguished sparks which may be carried over the edge of the water reservoir, may descend and be discharged. We omit the claim, as it refers to the drawings, and could not be understood without them, but it is confined to the arrangements of the parts above described.

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22. For an improved vessel, or *Locomotive Steamer;* George Burnham, Philadelphia, Pennsylvania, December 10.

The patentee says:—"My vessel, or locomotive steamer, is to be rendered buoyant, and to be propelled by means of hollow, air-tight floats, in the form of drums, or spheriods, or spheres, which are to be of such capacity as to sustain the vessel and its load, without the dipping of any part of the hull, or body, of the vessel into the water, and without the submersion of any larger portion of such hollow floats than shall be compatible with their being advantageously used, to carry buckets or paddles, for the purpose of propelling said vessel. These floats are to operate in water in a manner somewhat resembling that of the propelling wheels of locomotives on land; but they must, of course, be furnished with buckets, or paddles, to act upon the water in the manner of the ordinary paddle wheels of steamboats.

"I do not claim to be the first to have used buoyant cylinders, or floats, having paddles or buckets upon their peripheries; but what I do claim therein, and desire to secure by letters patent, is the using of revolving floats for obtaining buoyancy, and as propellers, in the manner herein set forth: that is to say, said floats being in diameter equal to that of the paddle wheels ordinarily employed, and like them, rising above the deck of the vessel, and being furnished with buckets, or paddles, the outer edges of which are to be on a line, or nearly so, with that of the peripheries of the floats."

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23. For an improvement in the machine for *Hulling Oats, Barley, &c.;* James Andrews and Enoch Piper, Camden, Waldo county, Maine, December 10.

This patent is for an improved mode of constructing the drum or disk of what is known as the "Scotch Barley Huller." The im-

proved machine consists simply of a stone disk, or short cylinder, revolving, with great velocity, within a case which revolves very slowly in the same direction. The disk is made of wood, covered with sheet iron, and studded with nails.

Claim.—"What we claim as our invention and improvement, is the manner of constructing the drum, or disk, of wood—sheathed with sheet iron, and armed with projecting nails, the same to revolve within a revolving case, or, in other words, that portion of the combination of a revolving drum or disk with a revolving case, so far as relates entirely to the manner of constructing the drum or disk, the whole being constructed and operating in the manner set forth."

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24. For an improved machine for *Cutting round Tenons;* Mahlon Gregg, Philadelphia, Pennsylvania, December 10.

The requisite guides and cutters are attached, by screws, to a face plate on a lathe. The screws which secure the guides pass through elongated holes or slots, so that they can be set to any sized tenon, and all at equal distances from the centre. One of the guides forms a part of a plate to which the cutters are attached, and the cutters are so formed as, when properly adjusted, to cut the surface of the tenon and the shoulder. They are fastened by a screw and staple, and their distance from the centre of the face plate may be regulated at pleasure.

Claim.—"What I claim as constituting my improvement, and desire to secure by letters patent, is the manner in which I have arranged and combined the face plate, and the adjustable cutter and guide pieces, so as to adapt the machine to the cutting of tenons and cylinders of different sizes."

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25. For improvements in the *Machine for Making Crackers;* Humphrey Winslow, Swansey, Massachusetts, December 14.

The dough is rolled to the proper thickness by sets of rollers in the usual manner, it is then carried under the cutters by a belt. The cutters are pressed down, and in rising, the dischargers, which occupy the space between the cutters, throw out the scraps upon the belt, which moves forward to present a fresh piece of dough; in the meantime a plate, called a conveyor, passes between the dough and the cutters, on to which the crackers are discharged by pistons working inside the cutters, and as this plate is withdrawn it is inclined, which causes the crackers to slide on to a board properly situated to receive them.

The claim refers throughout to the drawings.

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26. For machinery for *Manufacturing Felt Cloth;* Thomas R. Williams, an American Citizen now residing in London, England, December 14.

This apparatus consists of a combination of several machines employ-

ed continuously and consecutively, in the process of making cloth, without spinning or weaving, of wool, fur, or other animal fibre possessing the quality of felting.

The first machine is for forming the wool, &c., into a bat. It consists of a card, and two long belts which pass over rollers in opposite directions, so that the upper surface of the lower, shall be immediately under the lower surface of the upper belt. These two belts receive the sliver from the doffer of the card, and it is wound on one of them until a sufficient number of slivers have been wound on to make the bat of the required thickness; the bat is then cut, and wound on a roller, and taken to the second or hardening machine. This hardening machine consists of two rows of rollers covered with cloth or other elastic substance, one set immediately over the other; these are made to revolve slowly and the upper set receive a longitudinal vibratory motion. Between the lower set of rollers there are perforated pipes through which steam, and dry heat, are applied to the bat, as it passes between the rollers. The bat, thus partly felted, is taken to the last machine, which is composed of two sets of rollers operating like the hardening machine, excepting that the upper set do not vibrate longitudinally—the two sets of rollers have an alternate reciprocating motion on their axes, the motion being greater in one direction than in the other. The bat is placed in folds between two belts, and thus passes between the two sets of rollers, the lower set being partly immersed in suds.

Claim.—"I claim as my invention the different members of this combination collectively; as they are united and dependent on each other for producing a continuous and connected, or combined, result, that of the manufacture of commercial pieces or ends of cloth without spinning or weaving."

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27. For an improved mode of *Constructing the Chain and Floor of Endless Chain Horse Powers* for driving machinery; Orestes Badger, Cooperstown, New York, December 14.

The pieces constituting the floor, instead of being attached to a belt or to chains, are composed of plates of iron cast with a hook on the under side, towards each end; and these when hooked together, by links, constitute an endless chain. The upper surfaces of these plates are cast with flanches, or ledges, to receive pieces of wood for the horse to tread on. The rack which mashes into a cog wheel on the shaft which conveys the power, is cast on the under side of the plates, and as the chain passes over two polygons at each end, which would throw the rack out of gear if made straight in the usual way, it is cast so as to consist of a series of arcs of circles—the teeth of which will always be in gear with the cog wheel, and thus correspond with the rise and fall of the floor.

Claim.—"I do not claim the formation of an endless floor machine as that has been done by endless chains running over cog wheels with the floor secured to said chains in various ways. But I do claim the constructing an endless floor without an endless chain in the manner

above set forth, by means of hooks cast on the floor, and links connecting the floor plates together, in the manner set forth in the specification. I do also claim constructing the endless rack attached to the floor, composed of a series of arcs of circles, for the purpose and in the manner specified. And I also claim constructing the floor plates with dovetail flanches in order, cheaply and firmly, to secure the wooden plank upon the plates, so that the horse may travel more easily upon the wood than upon iron, and that being constructed and secured in that manner, the wooden plank can easily be taken out and replaced when worn."

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28. For a mode of *Propelling Boats by Jets of Water;* Hugh Ronalds, Albion, Illinois, December 14.

The propelling of boats by means of jets, or currents of water, has repeatedly been patented in Europe and in this country, under various modifications; in the present plan there are two cylinders lying horizontally in the vessel, and open at the stern. These cylinders are each provided with a piston impelled by a steam engine. The improvement claimed is to the making of the inner ends of the cylinders open to the atmosphere for the free egress and ingress of the air during the back and forward movement of the pistons, the water as it flows into said cylinders doing so by hydrostatic pressure only.

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29. For an improvement in the *Stump Extractor;* Eleazer Marble, Wyalusing, Bradford county, Pennsylvania, December 14.

An axle-tree, with a truck wheel and a swingle tree at each end, is jointed at its middle to a bar which is made fast to a stump of a tree, or other permanent body, by means of a chain. Two bars, perforated with holes from end to end, are jointed at one end to a clevis, made fast to the stump to be extracted, their other ends passing through a slot on each side of the middle of the axle-tree; the axletree is connected by means of a pin with either of the bars, alternately, and in such a manner as that the leverage can be increased at pleasure, by attaching it to the bar nearer the fulcrum. A horse, or horses, applied at each end of the axletree, pull in opposite directions.

Claim.—"What I claim is the combination of the perforated bars with the axle of the truck, perforated in the manner described, so as to allow of the bars being shifted to produce greater or less leverage —the axle being attached at its centre to the stump by a rod or other similar means, as described."

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30. For a mode of *Preventing Water from beating under Doors;* Alexander Kirkpatrick, city of Newark, New Jersey, December 14.

A kind of saddle is to be placed on a door sill, to catch and conduct off the water which beats under the door; this saddle is made with a groove running along under the door and communicating with basins which receive the water that runs into the groove, and which

is discharged through apertures along the outside edge. A tongue or fillet is let into the groove during dry weather to prevent dust from falling into it, and this is to be removed when rain is expected.

Claim.—"What I claim is the constructing of a saddle for door sills with a groove, basins, and apertures, as above specified, combined with the sill and door of dwelling houses and other buildings, either with or without the tongue, or with, or without the plate between the saddle and the sill, whether the same be effected exactly in the way herein described or in any other operating upon the same principle and producing similar results."

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31. For a machine for *Overhauling Cloth while Fulling;* John Tillou, city of New Haven, Connecticut, December 14.

The patentee says—"The design and object of my machine is to remove mill-wrinkles, and to make a smooth surface on cloth by means of a force so applied as to stretch the cloth widthwise, while the rolling cylinders passing the cloth, draw and stretch it lengthwise." "The principle is applicable to machinery for overhauling cloth while fulling, and for extending cloth while napping or shearing, or in lieu of revolving temples for weaving."

Two pairs of chains working over rollers and armed with rubbers, pass over and under the surface of the cloth at right angles to its length, the two nearly meeting in the middle of the cloth, and running in opposite directions, rub out the wrinkles—this is called the "transverse rubber." The cloth after leaving these chains passes between two sets of oblique rollers, the axis of one set forming an obtuse angle with the other, called "oblique stretchers," which stretch the cloth width-wise.

Claim.—"What I claim as my invention and desire to secure by letters patent is the transverse rubber and oblique stretchers, separately and in combination, for the purpose and in the manner described."

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32. For an apparatus for *Raising Water*, called the *Ælopile Hydraulic Apparatus;* Pierre Ravard, Paris, France, assigned to Eugene Ablon, of New York, December 17.

We make the following extract from the specification to give the reader a general idea of the principle on which this apparatus operates. The claim, which is of considerable length, makes reference throughout to the drawings.

"It is a well known fact that when steam is allowed to escape rapidly through a small orifice into the atmosphere, it carries with it a considerable portion of the surrounding air, and that the instrument denominated the ælopile has been, from this circumstance, proposed to be applied to the blowing of air into forges and furnaces. The same principle is also applied in the locomotive steam engine to create a partial vacuum in the furnace, by projecting a jet of waste steam up the chimney, which carries with it a large portion of air, thereby ef-

fecting the object desired. In my apparatus for raising water I apply the same principle to the producing of a partial vacuum in suitable receivers, into which water is then to be forced from the well, or other reservoir, by the pressure of the atmosphere."

The claim is to the combination and arrangement of the various parts of the apparatus with the view of applying the principle above indicated, to the raising of water.

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33. For an improvement in the manner of *Connecting the Piston Rod with the Pistons of Steam Cylinders*, of pumps, of blowing machines, and other engines in which the piston is to be double acting; Matthias W. Baldwin, Philadelphia, Pennsylvania, December 17.

The patentee says—"The object of my improvement is, by dispensing with the guides as commonly used, and with the pitman, or rod, usually employed, to connect the crank, or working beam, with the piston rod, and which in confined situations cannot be made of sufficient length to be advantageously employed, to combine the pitman and piston rod in one, by which the whole length of the piston rod is, in effect, added to the pitman. In carrying my improvement into effect, I connect the outer end of the piston rod, by means of a joint pin, directly to a crank, or to a vibrating beam, or lever, as the case may be; and the inner end thereof I likewise connect to the piston, by means of a joint pin, by which device the piston rod is allowed to vibrate laterally to that extent which may be necessary for the throw of the crank, or of the curve formed by the motion of the beam, or lever. In the upper, or outer, head of the cylinder I make a longitudinal slot, or opening, of sufficient length to admit of the lateral vibration of the piston rod, resulting from its mode of connexion, and this slot, or opening, I cover with a jointed hub, or with a slide, and connect the same with a stuffing box, to embrace the piston, constructing these parts in such manner as to keep them steam, water, and air tight, whilst the necessary freedom of motion is allowed."

"What I claim as my invention, and desire to secure by letters patent, is the attaching of the piston rod of a double acting steam, water, blowing, or other engine, directly to a lever beam, or crank, at one end, and to the piston at the other, causing the same piston rod to pass through a stuffing box connected with a jointed hub, or with a slide, so formed and arranged as to admit of the lateral vibration of the piston rod, substantially in the manner herein set forth."

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34. For improvements in the *Cooking Stove;* Jordan L. Mott, city of New York, December 17.

"The first improvement," the patentee observes, "consists in the employment of two cast iron, movable jambs, in combination with a tin reflector adapted thereto. The movable jambs consist of two plates of cast iron, in a triangular form, which, when roasting is to be effected in front of the fire, are received and retained in place by

means of suitable ledges on the hearth and front of the stove. The tin reflector used in combination with these jambs does not differ from other tin reflectors used for the same purpose, excepting in the giving to it that form which adapts it to the jambs, and to the "particular stove to which it is to be applied." "What I claim in this part of my improvement, is the combining with a cooking-stove of any of the kinds in which roasting is to be effected in front, two movable jambs, and a tin reflector, arranged and operating substantially as herein described."

"My second improvement consists in the manner of constructing, combining, and arranging a movable door, or shutter, which I denominate a fuel saver, and of adapting the stove thereto; which fuel saver is intended to produce a more perfect combustion of the fuel, and also to form a projecting shelf or hood over the fire, by the aid of which, when the coals are drawn out in front of the stove for the purpose of broiling, the fumes produced are effectually conducted into the fire-place. This movable door, shutter, or fuel saver, is hung upon hinges, but is capable of being lifted entirely out of its place in the front of the fire, so as to leave the whole of the fire-place completely open; it may also be raised up and sustained upon ledges, so as to inclose the upper portion of the fire-place, and to leave a passage under its lower edge for the free admission of air to the fire; it is likewise capable of being raised to a small height from the hearth, and made to incline forward for the purpose of drawing the ignited fuel towards the front, so as to occupy the opening left between its lower edge and the hearth; and when this has been done, it can be replaced without difficulty, and without disturbing the coal which has been raked forward; and, as before remarked, it may be removed from the front of the fire, and so placed as to constitute a shelf, or hood above it, by which the smoke and fumes from broiling, or other cooking operations, may be carried off into the fire-place." "What I claim as constituting my second improvement in cooking stoves, is the above fuel saver, door, or shutter, as constructed and combined with the hearth, front plate, and fire-place of a cooking stove of any kind to which it can be adapted, in the manner herein set forth, by which said door is rendered capable of being raised or lowered, inclined forward, or converted into a hood, or shelf, for the purpose and in the manner fully made known."

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35. For a process of *Tanning Hides and Skins*, by means of an apparatus adapted to that purpose; Daniel Howell, of New York City, Assignee of Walter Buchanan, December 17.

The apparatus described in this patent is simply a large wheel, the periphery of which is composed of rounds extending from head to head, revolving vertically in a tan vat, the sides of which, towards the top, flare outwards to catch the ooze that drips from the hides or skins as they are carried around by the wheel, to the respective rounds of which they are hung by their middles. The wheel is to be kept constantly turning, so that the hides or skins shall be alternately immersed in, and removed from, the tanning liquor.

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"What I claim as my invention, and desire to secure by letters patent, is the attaching of the piston rod of a double acting steam, water, blowing, or other engine, directly to a lever beam, or crank, at one end, and to the piston at the other, causing the same piston rod to pass through a stuffing box connected with a jointed hub, or with a slide, so formed and arranged as to admit of the lateral vibration of the piston rod, substantially in the manner herein set forth."

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means of suitable ledges on the hearth and front of the stove. The tin reflector used in combination with these jambs does not differ from other tin reflectors used for the same purpose, excepting in the giving to it that form which adapts it to the jambs, and to the "particular stove to which it is to be applied." "What I claim in this part of my improvement, is the combining with a cooking-stove of any of the kinds in which roasting is to be effected in front, two movable jambs, and a tin reflector, arranged and operating substantially as herein described."

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The apparatus described in this patent is simply a large wheel, the periphery of which is composed of rounds extending from head to head, revolving vertically in a tan vat, the sides of which, towards the top, flare outwards to catch the ooze that drips from the hides or skins as they are carried around by the wheel, to the respective rounds of which they are hung by their middles. The wheel is to be kept constantly turning, so that the hides or skins shall be alternately immersed in, and removed from, the tanning liquor.

Claim.—"What I claim as my invention is the tanning of hides and skins, by attaching them to, or hanging them by the slats or rounds of, a wheel, such as is herein described; said wheel being placed over a tan vat, in such a manner as that by its revolution, the skins shall be alternately dipped into and raised from the tanning liquor by a motion which is to be continuous, or nearly so, during the process. Not intending, however, by the foregoing claim, to limit myself to the precise form of the apparatus as herein described, but holding myself at liberty to vary the same as I may think proper, whilst I attain the same end by means substantially the same."

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36. For an improvement in the *Truss, for the cure or relief of Prolapsus Uteri, Hernia, &c.;* Goodown Bright, Bellbrook, Greene county, Ohio, December 17.

The following extract from the specification, together with the claim, will afford a tolerably clear idea of the improvements, viz:—"My improvements consist mainly in the manner in which I combine two elastic springs and back pads, with an abdominal pad; and in the manner in which I construct and combine with said abdominal pad a bifurcated steel spring, which I usually form of wire, and which sustains a perinæal pad, whilst it leaves the urinary passage unobstructed." "What I claim and desire to secure by letters patent, is the manner of attaching to the abdominal pad an elastic bifurcated wire or steel spring, carrying a perinæal pad, the same being constructed, and operating in the manner and for the purpose made known."

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37. For improvements in the *Apparatus for Manufacturing Pipes of Lead;* George Escol Sellers, Township of Upper Darby, Delaware county, Pennsylvania, December 17.

The first improvement claimed in this patent is for the forcing of the molten lead from the melting pot, through the dies that are to form the pipe. The pressure of air is applied to the surface of the lead by means of a forcing pump, the air being heated on its way to the pot by passing through a tube coiled around its outside, and within the flue of the furnace.

The second improvement is in the manner of cooling the nozzle, or former, by the circulation of cold water around it, this being effected by forcing a stream of that fluid through a pipe coiled around said nozzle, or former, within which there is a mandrel, or core, which forms the bore of the pipe.

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38. For an improvement in the machine for *Spinning Silk;* George Heritage, Chestertown, Kent county, Maryland, December 19.

This machine is for spinning silk directly from the cocoons, and giving the necessary twist to it at the same time. The cocoons are placed in revolving pans, (for a description of which the reader is referred to the notice of the patent next following) which give the first twist to the strands; the threads are then guided to two square

shafts, around which they pass, the axles of which are parallel; these are divided into sections of different diameters, for the purpose of drawing the threads from the cocoons with different degrees of velocity, to give different degrees of fineness and twist; the threads pass thence to the flyers and spindles, which are of the usual construction.

Claim—"What I claim, is the combining of the revolving basins, or vessels, in which the cocoons are contained, with the apparatus for spinning the same into thread; the single strands receiving their twist from the revolution of the basins, and these being doubled and twisted by the spinning apparatus, the whole being arranged and combined substantially in the manner herein set forth. I also claim the use of the graduated square, or triangular, shafts, for the purpose of holding the strands and unwinding the silk from the cocoons with different velocities, in the manner and with the intention herein described."

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39. For an improvement in the machinery for *Reeling Silk from the Cocoons;* George Heritage, Chestertown, Kent county, Maryland, December 19.

It is observed in the specification, that "in the ordinary mode of reeling silk from the cocoons, and forming from it what is known under the name of raw silk; the fibres from the respective cocoons form a flat, angular, or irregular thread, as they do not receive any twist on their way to the reel from the basin or vessel containing them. By my improved machinery, I cause the respective fibres which are to form one thread, to twist together, as the cocoons are unwound, and in consequence of such twisting to form a round thread when wound upon the reel, which round thread is much better adapted to various uses in the silk manufacture, than the raw silk as heretofore formed." To effect this, the basin in which the cocoons are placed is attached to a spindle with which it revolves, and the basin is divided into compartments, so that the water contained in it, with the cocoons, revolve with it, and give the desired twist.

Claim.—"What I claim as my invention is, the giving to the threads of raw silk, in the operation of reeling the same from the cocoons, such a degree of twist as may be desired, by giving a revolving motion to the basins, or vessels, in which said cocoons are contained, the same being effected by an apparatus constructed in the manner herein set forth."

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40. For improvements in the *Cooking Stove;* William Melsheimer, city of Philadelphia, Pennsylvania, December 19.

This stove has four ovens; two of these are at the ends of the grate, or fire chamber. These are necessarily shallow, but boilers may be so constructed as to be placed in part within them. There is a third oven immediately behind the fire chamber, and above this is the fourth oven, which stands above what is ordinarily the top plate of the stove. This oven projects in part over the fire chamber, and is surrounded on four sides by flues. The lower flue passes over the top of the oven which is behind the fire chamber, said oven receiving its heat from

this flue, and from the back plate of the fire chamber. The whole is to operate without dampers, the heat and draught being regulated by the different capacities of the flues.

Claim.—"What I claim, and desire to secure by letters patent, is the manner in which I have arranged and combined the four ovens; one at each end of the fire chamber; one immediately behind the fire chamber, with a flue passing over the top of it only; and the fourth or principal oven situated immediately above this, and extending in part over the fire chamber, as set forth." "I also claim the manner of graduating and arranging these flues, so as to render their regulation by dampers unnecessary when the oven is to be heated; said graduation and arrangement being substantially the same with that herein made known."

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41. For improvements in the *Spark Arrester;* Leonard Phleger, Philadelphia, Pennsylvania, December 28.

This patent is for improvements on the spark arrester, patented by Mr. Phleger on the 10th of September, 1840, and noticed in this Journal vol. ii, page 337; to which the reader is referred. The first improvement is in substituting for the elbow pipes extending from the bottom to the top of the outer case, in the former patent, openings near the top and bottom of said case, and then adding a jacket outside of the whole. The second improvement is in dispensing with the perforated cone of metal, and substituting a conical, or cylindrical, tube perforated with large holes near the top and bottom, through which the draught, sparks, &c., pass into the space between this, and what constitutes the outer case, as described in former patent; and in adding a cap over the space with a flanch extending down a little below the top of, and of greater diameter than, the outer case, by which the draught, &c. is carried to the space between this outer case and the jacket outside of it, as above mentioned.

The claim is confined to these two improvements.

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42. For improvements in the *Cooking Stove;* Joel Greene, Rochester, Monroe county, New York, December 28.

This is a modification of that kind of stoves in which the fire chamber is above the oven. The side plates of the fire chamber extend up to within a short distance of the top plate, which is pierced to receive boilers, &c., and form, with the side plates of the stove, the side flues, the side plates of the oven being immediately under the side plates of the fire chamber. The bottom plate of the fire chamber forms the top of the oven, and extends through the side flues, and is there perforated with square holes, provided with registers to regulate, or stop, the draught, and prevent its circulation around the oven. The oven extends from the front to the back plate, and in the back of the side flues there are flues called angle flues, formed to conduct the draught to the funnel, or pipe, at the back. There is an opening leading from the back of the fire chamber directly into the pipe, or funnel,

governed, as usual, by a damper. Between the bottom plate of the oven and the bottom of the stove, are arranged oblique plates to conduct the draught in various directions under the oven.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the side flues in combination with the angle flues and funnel as before described. Likewise the arrangement of the register for governing the draught, in combination with the oblique plates under the oven, as described."

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43. For an improvement in *Wind Mills;* Isaac Garver and Samuel Fahrney, Washington county, Maryland, December 28.

This patent is for a mode of setting and shifting the sails of wind mills. The backs of the sails are jointed to the arms, and a rod, attached to the back of each sail, is connected with a thimble on the shaft, by sliding which, the angle of the sails is changed. The sails are kept at their greatest angle by a spring, the end of which is forked and fits into a groove made for that purpose in the thimble. A cord attached to the thimble passes over pullies and down to within reach of the operator, by means of which the tension of the spring can be overcome, and the sails shifted.

The claim is to the "arrangement of the rods attached to the back of the sails and to the rim of the thimble, and in combination therewith a spring for keeping the sails in an extended position, instead of cords and weights, which have been used."

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44. For a *Fire Alarm;* Rufus Porter, Bellerica, Middlesex county, Massachusetts, December 28.

The apparatus described in this specification, is for giving notice of fire in a building by the expansion of a bent bar of metal, the ends of which are made fast to the bottom of the case of the alarm, and its middle connected by a rod and hook with a trigger which holds the hammer of the bell. The expansion of the bent bar, which is held by both ends, increases the curvature and thus pulls the trigger.

The patentee disclaims the invention of applying the expansion of a bar of metal by heat, to disengage, or liberate an alarm, and limits his claim to the combination of the bar of metal with the parts constituting the catch and trigger, and with the hammer of the bell; and also the arrangement of parts constituting the escapement for working the hammer, a description of which we omit, as it could not well be understood without drawings.

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45. For improvements in *Rail Ways, and in the mode of applying power to propel carriages thereon;* John Rangeley, Camberwell, England, December 28; patent to run 14 years from March 3, 1840.

The claim on which this patent was granted will give a good general idea of the principle of the invention, viz: "The nature of my invention, and the best manner I am acquainted with of performing the same, having been thus described, I declare that I lay no claim to

the various parts separately, nor do I confine myself to any precise arrangement of the details, so long as the peculiarity of my invention be retained; and, although I have spoken of the steam engine, which I consider will be the best motive power, in most cases, I do not confine myself thereto, as other power may be employed. But what I claim, is the mode herein described of constructing railways, whereby the power employed to propel carriages thereon is transmitted by a series, or train, of wheels, revolving on axles supported on stationary bearings fixed in the line of rail way, and in such manner that the carriages for passengers and goods are caused to pass over and be acted on, and moved by, the rotary motion of such wheels, by the contact and friction of their peripheries acting against the undersides of the pair of running rails attached to each carriage, the wheels being driven by endless bands leading from the moving power."

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46. For an improvement in *Gudgeons, and in the mode of securing them to shafts, &c.;* David Philips, Georgetown, Mercer county, Pennsylvania, December 28.

"The nature of this improvement consists in making the gudgeon with wings radiating from its periphery, and with notched arms projecting from said wings nearly at right angles and in an opposite direction from that of the gudgeon, which arms and wings are let into the shaft in channels made therein; the wings being let into the ends, and the arms into the sides of the shaft, which arms are secured by keys let into cross grooves in the shaft, and driven into the notches of the arms, which draw the gudgeon firmly against the ends of the shaft, and which are farther secured by bands passed over the arms and shaft." "What I claim as my invention, is the mode of attaching and securing the gudgeon to the shaft by means of the notched arms and key, as described."

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47. For a *Cooking Closet*; Joshua Grime, Beekmantown, Westchester county, New York, December 28.

An iron closet, with doors, and bars extending across to receive sheets or plates of metal, is built in the jambs of a chimney. A fire chamber is built in the bottom, with an ash receiver and draught hole, and over this fire chamber is a tube extending to the top, the lower end being funnel shaped, to receive and conduct off the smoke, &c. to the flue. There is an opening at top leading into the flue of the chimney, and governed by a damper, for the purpose of heating the closet in the manner in which ovens are heated. The various articles to be cooked and baked are placed on the shelves or plates, and the doors are then shut to confine the heat.

The claim is to the "combination of a chimney flue or other convenient means to create draught and carry off the smoke, gas, &c., with a closet constructed with the draught hole, fire chamber, and the opening and damper at top."

48. For an improvement in the *Coffee Roaster;* Abel Stillman, Poland, Herkimer county, New York, December 28.

This roaster consists of a sheet iron cylinder, hung on gudgeons, which have their bearings in a plate made to fit the boiler hole of a cooking stove, so as to expose the surface of the cylinder itself, when revolving, to the direct action of the heat. There is a hole made in the end of the cylinder, covered with mica, through which to see, when the coffee is sufficiently roasted.

Claim.—"I do not claim as my invention the combination of a cylinder for roasting coffee, with a vessel adapted to the boiler openings of a stove; said vessel having a bottom to it so as to exclude the fire from the heater; but what I claim, is combining the coffee roaster with a rim or vessel, open below, so as to admit the fire to the roaster, and adapted to the stove, portable furnace, or fire place as herein set forth, and the insertion of a piece of mica or other transparent substance in the end of the cylinder."

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49. For an improvement in the *Spark Arrester;* David Matthew, Schenectady, New York, December 31.

To the top of the chimney is attached a plate with a hole in the middle, larger than the diameter of the chimney, and to this is attached a short conical pipe. The outer edge of this plate is connected with another plate, about fifteen inches above it, by a wire gauze, and the upper plate is provided with an inverted cone, placed immediately over the chimney. The lower plate, first mentioned, is pierced with five holes, surrounded by conical pipes extending down a short distance, to conduct the sparks into the space between the chimney and the outer casing. The smoke, sparks, &c., pass up the chimney, strike against the cone, and are turned off, the sparks falling through the small conical tubes in the lower plate into the space between the chimney and the outer casing, and the smoke, gas, &c., pass through the wire gauze and then out at the top, between the wire gauze and the outer casing. The claim is confined to the combination of the two plates, constructed in the manner described, having a wire gauze arranged between them, with the casing surrounding the chimney of the locomotive in the form as above set forth.

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50. For improvements in the manner of constructing *Locomotive Steam Engines;* Matthias W. Baldwin, Philadelphia, Pennsylvania, December 31.

"My improvement consists in a new mode of arranging the gearing and general connexion of the driving and truck wheels, in which arrangement the connecting axle is retained in its place, in part by being confined to the engine frame, and in part by the truck frame, in consequence of the particular manner in which I construct said frame." The intermediate axle, which lies between the two axles of the truck wheels, is driven by shackle bars from the driving wheels.

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1 Ph	30.01	5	⅓	2	⅔	4⅔	1	.	3	....	.	......	....	..	1545
2 Me															
3 Be	30.00	12⅓	⅔	1⅓	.	8½	.	.	2½	....	.	......	....	..	1537
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6 M	29.57	6⅔	.	6⅔	.	2½	.	.	9½	....	.	......	....	..	1545
7 Pi															
8 W															
9 S	28.13	6⅓	.	12⅓	.	8	.	.	.	....	.	......	....	..	1576
10 La															
11 S	29.32	2⅔	.	6⅔	.	1½	.	15	2	....	.	......	....	..	1548
12 B															
13 C															
14 D	29.46	6⅔	1⅓	2	1⅓	⅔	.	1	10	59.50	1	......	71.00	1	1553
15 L	29.54	4⅔	2⅔	3	1	3⅔	2⅔	.	.	59.52	.	......	68.19	.	1554
16 Y															
17 L															
18 D	29.71	8⅔	.	13	.	4⅓	.	.	1	....	.	......	....	..	1536
19 N	29.51	1	.	4⅔	.	2⅔	.	3⅔	⅓	....	.	......	71.00	..	1541
20 C															
21 H															
22 T															
23 L															
24 U															
25 M															
26 J	29.46	2	.	1⅓	.	3½	.	17⅔	4	....	.	....	....	..	1540
27 P															
28 C															
29 A	29.40	4⅔	1⅔	1⅔	⅓	1	1⅔	5⅓	.	59.75	16	......	66.25	16	1560
30 F															
31 B	29.39	.	.	22⅓	.	.	.	.	2	....	.	......	....	..	1557
32 C	29.27	2⅓	1⅔	2⅔	⅓	1⅔	⅓	1	16⅓	....	.	......	....	..	1551
33 F															
34 M	.....	4⅔	⅔	14	.	4	⅓	.	1⅔	....	.	......	....	..	1555
35 C															
36 C	28.00	6	.	9	⅓	5	.	3⅓	3½	....	.	......	....	..	1549
37 H	29.25	5⅔	5	⅓	12⅓	5	.	.	⅔	....	.	.. .	....	..	1539
38 S	27.93	4⅓	.	2	1⅓	2⅔	.	11⅔	6⅔	....	.	......	75.07	11	1543
39 I	28.80	5	.	17	.	.	.	7⅓	.	....	.	......	....	..	1636
40 J															
41 V															
42 V	28.98	1	.	.	.	20⅓	.	.	8⅔	....	.	......	....	..	1556
43 A															
44 V															
45 F	29.07	9⅔	.	6⅔	.	5	.	5⅔	.	....	.	......	....	..	1606
46 G															
47 V															
48 A	29.27	2⅓	.	2	⅔	7⅔	⅓	7⅔	2	....	.	......	....	..	1552
49 R	29.39	3	.	1	.	16⅓	.	6⅔	1⅓	....	.	......	....	..	1589
50 D	28.89	3	.	18	.	1⅔	.	.	.	....	.	......	....	..	1544
51 I															
52 C	28.73	⅔	.	1⅓	.	1	.	14⅔	1⅔	....	.	......	....	..	1542
53 I	29.43	4⅓	1⅓	7½	⅓	⅓	1⅔	3⅓	.	....	.	......	....	..	1680

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OF THE

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AND

MECHANICS' REGISTER.

MARCH, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. By L. KLEIN, *Civil Engineer.*

[CONTINUED FROM PAGE 79.]

IV.—*Emperor Ferdinand's Northern Railroad.*

The fourth railroad undertaken in Austria is the most extensive in Europe, as it will, when completed with all its branches, have a length of nearly 400 miles; I shall therefore be excused for giving a somewhat more detailed account of it. The main line commences at Vienna, the capital and residence of the Austrian Empire, and terminates at Bochnia in Galicia; from this line branches go to Stockerau, Brunn, Olmutz, Troppau, Dwory and Wielitchka; a branch is also to lead to Presbury in Hungary.

Though projected as early as 1830, it was not until the 4th of March, 1836, that the imperial privilege for this gigantic undertaking was granted to Baron Rothschild, in Vienna, authorizing the formation of a company with a capital of seven millions of dollars. The latter was immediately subscribed, and on the 7th of April, 1837, the works were commenced. In November of the same year, the first trips were made to Wagram, a distance of seven miles, and on the 7th of July, 1839, the line from Vienna to Brunn (the capital of Moravia) was put into operation. With the forty-nine miles opened in the present year, there are now 140 miles in operation, and forty miles more will be comple-

ted in the course of two months. Other fifty-three miles are in progress of construction, and as many miles located, which will be commenced as soon as the necessary funds are procured.

Amongst the principal objects of the northern railroad is the transportation of oxen from the interior of Galicia to the Residence; it has been estimated, that not less than 90,000 are coming annually in this direction. By connecting several important cities with Vienna, this railroad will also command a great travel and a considerable traffic in produce and merchandize; it will in every case contribute largely to develope the resources of those provinces through which it passes, and will become still more important by its connexion with the Warsaw and Vienna, the Bochnia and Lemberg, and the Upper Silesian railroads, of which the first and the third are already in progress.

The following sections of the Emperor Ferdinand's northern railroad are either completed, or in progress of construction:

1. From Vienna to Lundenburg, main line, (opened)	48 miles
2. From Lundenburg to Brunn, branch, (opened)	43
3. From Lundenburg to Hradish, main line, (opened)	35
4. From near Vienna to Stockerau, branch, (opened)	14
5. From Hradish to Prerau, main line, (nearly completed)	26
6. From Prerau to Olmutz, branch, do.	14
Total length completed or nearly so,	180 miles
7. From Prerau to Ostrau, main line, (in progress)	53
8. From Ostrau to Oswiecin, where the Warsaw and Vienna railroad terminates, main line, (located, but not commenced)	49

Notwithstanding the great extent of this railroad, it meets no where with extraordinary difficulties; in passing the different summits, which divide the waters of important rivers, it requires neither tunnels nor inclined planes. The curves have no radius shorter than 1500 feet, and the steepest grade is 17.6 feet per mile, or 1 in 300. This grade has been adopted as a maximum for the whole line, it being regarded here, as in England, a very steep grade.

With the exception of only nineteen miles from Vienna, to where the branch road to Presburg is to leave the main line, the road has only a single track of the ordinary width of 4 feet 8½ inches. The width of the road bed is 12½ feet, and the slopes are = 1½ to 1. On the line from Vienna to Brunn of ninety-one miles, now two years in operation, the following works have been executed. Excavations and embankments, 6,012,500 cubic yards; 3708 feet of wooden bridges, the most remarkable of which are those over the Danube at Vienna of 1960 feet in length, with spans of 60 feet; 488 feet of wooden

bridges with stone piers; 24 stone bridges and viaducts with 228 arches of different spans; 116 culverts; 198 road crossings, of which 31 are under, 6 over, and the remainder level with, the railway.

The superstructure consists of the iron T rail of 40 lbs. per yard, resting in chairs fastened upon cross ties of oak, larch, or fir, 7½ feet in length and 12 inches in diameter, half round, and placed 3½ feet apart upon a bed of gravel, 12 inches thick. The chairs at the joints weigh 15 lbs., the others 12 lbs., and the rails are fastened into them by two iron keys driven in from both sides of the chair outside the track. The rails were partly imported from England, partly manufactured in Austria, and the cost per ton (2240 lbs.) was in both cases from 130 to 135 dollars! owing to the high duty on imported iron, and to the inexperience in the manufacture of rails at home. The price of the chairs was 44 dollars per ton, delivered to the road.

The system adopted here in letting the works is different from that generally followed in America, and deserves to be noticed. The line for a section of the railroad being definitely fixed and located, the profiles, showing the excavations and embankments, and the plans of all the works of art, as: bridges, viaducts, road-crossings, culverts, &c., are executed with the necessary detail, and then the estimates, founded upon the prices of materials and labour in the district through which the line passes, and which are ascertained with the utmost precision, are prepared accordingly. Contractors, of whom there are seldom more than two or three parties, then inspect the plans and estimates, and in their written proposals declare *for how much per cent. below the estimated amount* they offer to execute the works. Generally, the latter are let at from eight to twelve per cent. below the Engineers' estimates, and the contractors are nevertheless realizing a good profit. They let the works again in smaller sections to sub-contractors, who employ many female labourers, who work for low wages. The superstructure is not let to contractors, the object of the company being to insure a more solid and durable work.

Besides the principal depots at the termini of the main line and branch roads, and the smaller ones at the intermediate stopping places, there are along the line small houses for the men who watch and repair the road, at intervals of from 1 to 1½ mile; 80 such houses are between Vienna and Brunn.

The company own at present thirty locomotive engines, of which one was built in Vienna, twenty-four were imported from England, and five from America. Of the latter, the "Baltimore," manufactured by Messrs. Baldwin, Vail & Hufty, in Philadelphia, has been upon the road but a short time, and promises to surpass all others in her performances, as she does by her workmanship and the beautiful ar-

rangement of her parts. The other means of transportation consist in about 180 passenger cars of three different classes, and 200 freight cars. All the cars are four wheeled, and have wheels with wrought iron tires.

According to the last report of the Directors, the following sums had been expended up to the 31st of October, 1840:

For the principal station at Vienna,	197,862 Dollars.
" the section No. 1, from Vienna to Lundenburg,	1,450,832
" the section No. 2, " Lundenburg to Brunn,	1,262,877
" the other sections from Lundenburg towards Olmutz,	1,548,977
" a second track from Vienna to Gaensemdorf, and for other preparatory works towards the construction of the branch road to Presburg,	346,671
" the branch road to Stockerau,	77,547
Inventory account—outfit,	456,252
Interest account,	84,785
Surveys for the Railroad to Prague,	3,178
Total,	5,428,981 Dollars.

Up to the present period, the total amount expended by the company of the Northern Railroad, will exceed six millions of dollars.

Amongst the above sums is the interest paid to the Stockholders at the rate of $4.00 per annum on their instalments. It is a general custom on the continent, that Stockholders receive interest on the sums paid in by them, from the day of the first instalment until the road is put into operation. It is an expedient to induce those capitalists to subscribe, who would be unwilling to invest their money, if they had to wait several years, before getting any interest or profit. It needs not be mentioned, that the proceeding is entirely illusory, as the interest must be paid from the Stockholders' own money.

If we deduct this interest, we find the cost of the railway from Vienna to Brunn with the depot at Vienna, 2,713,586 dollars, and as the length is ninety-one miles, the cost per mile of railroad with a single track, exclusive of outfit was 29,800 dollars; with outfit 33,000 dollars.

From the first of November, 1838, to the 31st of October, 1839, in which period the railroad has been entirely opened only during four months, the total number of passengers conveyed was 263,886, the income 125,080 dollars.

In the year ending 31st of October, 1840, there have been transported over the road between Vienna and Brunn:

228,368 passengers, who paid	201,561 Dollars.
32,160 tons of goods	90,063
Income from other sources,	2,548
Total gross income,	294,172 Dollars;

or, 3,233 dollars per mile, equal to 10 per cent. on the capital of construction.

The expenses of working the railroad have been during the same period, 225,547 dollars, or 2,478½ dollars per mile, leaving only 68,625 dollars as net profit, which is 2¼ per cent. on the capital of construction. The number of miles traveled by all the engines was—188,100; the expenses per mile of travel amounted therefore to 1 dollar 25 cents. The principal cause of the comparatively large expenditure is to be found in the great cost of the fuel, for which coke and coal brought from great distances have hitherto been employed; the expenses for fuel alone amounted in 1840 to not less than 98,533 dollars, or to 52.4 cents per mile of travel.

Up to the first of April, 1841, the passenger fare has been per mile in the first class cars 3.16 cents, in the second class 2.01 cents, and in the third class 1.58 cents. The average receipt per passenger per mile in 1840, was 1.77 cents; the average income or charge per ton per mile 5.1 cents. Since April 1841, the passenger fare has been increased to 4.25 cents in the first, 2.65 cents in the second, and 1.77 cents in the third class cars.

In the course of this summer, several trials have been made with heavy transports of oxen from Hradish to Vienna, a distance of 83 miles. From 100 to 180 oxen were carried in a train, each car containing six to eight. The cars are open on top, and only provided with barriers on the four sides; the oxen stand sideways, and are tied on the car with ropes. As the trip is made in seven or eight hours, they receive no food on the road. A commission, specially appointed for this purpose, inspected the cattle when they arrived at Vienna, and declared, that the conveyance upon the railroad is in no way injurious. The butchers also were perfectly satisfied with the result, and are contented to receive their supply in this new manner.

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the new Track now being laid upon the Baltimore and Ohio Railroad, from Harper's Ferry in Virginia, to Cumberland in Maryland, a distance of 96 miles.

Communicated by BENJAMIN H. LATROBE, Civil Engineer.

The rail is of rolled iron, imported from England; it is of the bridge,

trough, or inverted U section,* 3⅜ inches in height, 4⅝ inches in width at the base, and 2⅜ inches from out to out of the sides of the upright stems; the bars are in lengths of 20 feet, with their ends cut square, and weigh 340 pounds each, or 51 lbs. per lineal yard.

The rolled iron rail, is supported throughout its length, by a *continuous bearing* of sawed timber, 4½ by 8 inches in section, and in lengths of 20 feet, like the *rail-bars* and *sub-sills.*

The *continuous bearing*, reposes flatwise upon *cross-ties* and *bearing blocks*, the *cross-ties* being 4½ by 6 inches in section, laid flatwise upon the *sub-sills*, and notched on the top 1½ inch deep and 8 inches wide, to receive the *continuous bearing;* this notch being cut ⅝ths of an inch deeper on the side next the centre of the track, so that the *continuous bearings* when laid on both sides, mutually decline towards each other at the rate of ⅝ths of an inch in 8 inches, or 1 in 13, thus bringing the top of the iron rail also, into a plane of this inclination, which is the same as that of the cones of the wheels now used upon the Baltimore and Ohio Railroad.

The *bearing blocks* are 3 by 6 inches in section, and 1 foot in length, they are laid crosswise to the track upon their flat sides, and support the *continuous bearing* at points intermediate to the ties, without any notching.

The *cross-ties*, are laid 5 feet apart between their centres, as are the *bearing blocks*, and hence, the *continuous bearing* is supported at points 2½ feet asunder, if we measure from centre to centre of the supports, or has unsupported spaces, of but 2 feet lineal in the clear between their sides.

The *cross-ties* and *bearing blocks*, rest upon *sub-sills*, 3 by 10 inches in section, and also in lengths of 20 feet; at every point of support, the *continuous bearings*, the *cross-ties* or *bearing blocks*, and the *sub-sills*, are pinned together by *tree-nails* 1¼ inch in diameter, and going quite through the three timbers; but where the joinings of the *continuous bearing* occur above a *tie*, two *tree-nails* of an inch in diameter (one in each of the meeting ends of the *continuous bearing*) are used.

The joinings of the *rail-bars* upon the opposite sides of the track, break joint with each other midway of their lengths; they also break joint at the same time with the *continuous bearings* upon which they rest, and these in like manner break joint with the *sub-sills;* every

* This pattern of rail, which in section very much resembles the letter U inverted, and hence, in technical phraseology, ought perhaps to be called the U rail; was invented by S. V. Merrick, Esq., of Philadelphia, in 1831, and by him denominated the *Trough rail*, from its resemblance when inverted, to a trough. (See the number of this Journal for August, 1835.) It has been used upon the Wilmington and Susquehanna Railroad, in this country, and the Great Western Railway in England, and continues to give very satisfactory results.—Ed.

joint of two adjacent timbers of the *continuous bearings*, is made to fall upon a *cross-tie*, and all the joinings in the track are merely square butt joints, no scarfs being used; by this system of distributing the weak and strong points, the strength of the track is equalized.

A cast iron *joint chair*, weighing $7\frac{3}{4}$ lbs. is placed under the ends of every two adjacent *rail-bars*, and a *centre chair*, also of cast iron, weighing 4 lbs. under the middle of each rail.

The *joint chairs*, together with the *rail-bars*, are fastened down on the *continuous bearing* by two vertical *screw-bolts*, (one on each side of the chair) going through oblong mortise holes made in the timber, and also, through similar apertures in cast iron *bearing-plates*, fastened up against the bottom of the *continuous bearing*, in the interval between two supports, but close to one: the *screw-bolt* is formed with an oblong square head, fitting the mortise hole in one direction only, so that by making a half turn with it after its head has descended below the *bearing plate* just mentioned, it laps over the sides of the oblong hole in that plate, and falling into a recess cast for the purpose, when drawn up by the nut, the *bearing plate* is thus made to grasp the *continuous bearing* firmly; whilst the nut being screwed down upon a wrought iron washer and zinc plate, (designed to protect the iron by galvanic action) which lap upon the projecting base, or feet of the contiguous bars of the U rail, they are thus secured to the joint chair, and the latter to the *continuous bearing*.

The *centre chair*, and the middles of the *rail-bars*, are held down on the *continuous bearing* by four *brad headed spikes*, (each $4\frac{1}{2}$ inches long and $\frac{7}{16}$ square in the shank;) and the iron rail between the *joint* and *centre chairs* is held by twelve similar spikes driven in pairs, (one on each side) at intervals of $2\frac{1}{2}$ feet.

The *chairs* are let their own thickness ($\frac{5}{8}$th of an inch) into the *continuous bearing*, so that their tops are flush with the upper surface of the latter, and the bottom of the rail bears fairly upon both.

The *chairs* have each a projection going up vertically into the hollow of the rail, and two horizontal semi-circular projections on their ends to fit into half round mortises in the wood, to prevent lateral motion.

The *centre chairs*, moreover, have two square projections on the upper surface, which fit notches of the same dimensions ($\frac{7}{8}$ths of an inch square) in the feet of the rail, to confine the bars from longitudinal movement.*

The whole of the track is laid upon, and partly imbedded into, a

* The *seat* of the rail in the chairs, is elevated about $\frac{1}{8}$th of an inch above the rest, and the castings being made as soft as possible, this admits of a portion of the seat being tooled away, whenever necessary, to enable a compensation to be made for small irregularities in the heights of contiguous rails.

ballasting of broken stone, composing a mass of open material—entirely pervious to water—10 feet wide at bottom, 8 feet at top, and 1 foot in depth: the lower part consisting of stone broken to pass every way through a 2 inch ring, and the upper part of such as will in like manner pass a 4 inch ring: the base of the *ballasting* is about 4½ inches below the bottom of the *sub-sill*, and its top, level with the upper surfaces of the *cross-ties*, or 3 inches below the top of the *continuous bearing*. The distance between the iron rails, or the *gauge of the railway*, is 4 feet 8½ inches.

References to the Plate.

A General plan of the superstructure.
B Side view do.
C Transverse section do.
D Side view at the joint of the rail, showing the rail and its fastenings to the continuous bearing.
E Cross section through the continuous bearing at the joint of a rail
F Plan of the joint chair.
G End view of do.
H Plan of the centre chair.
I End view of do.
J Plan of the bearing plate.
K Plan of the screw bolt.
L Cross section through the rib of the bearing plate.
M Plan of the nut and washer.

Scale of A, B, and C, ¼th of an inch to the foot, the remainder, being the *details*, are drawn quarter-size.

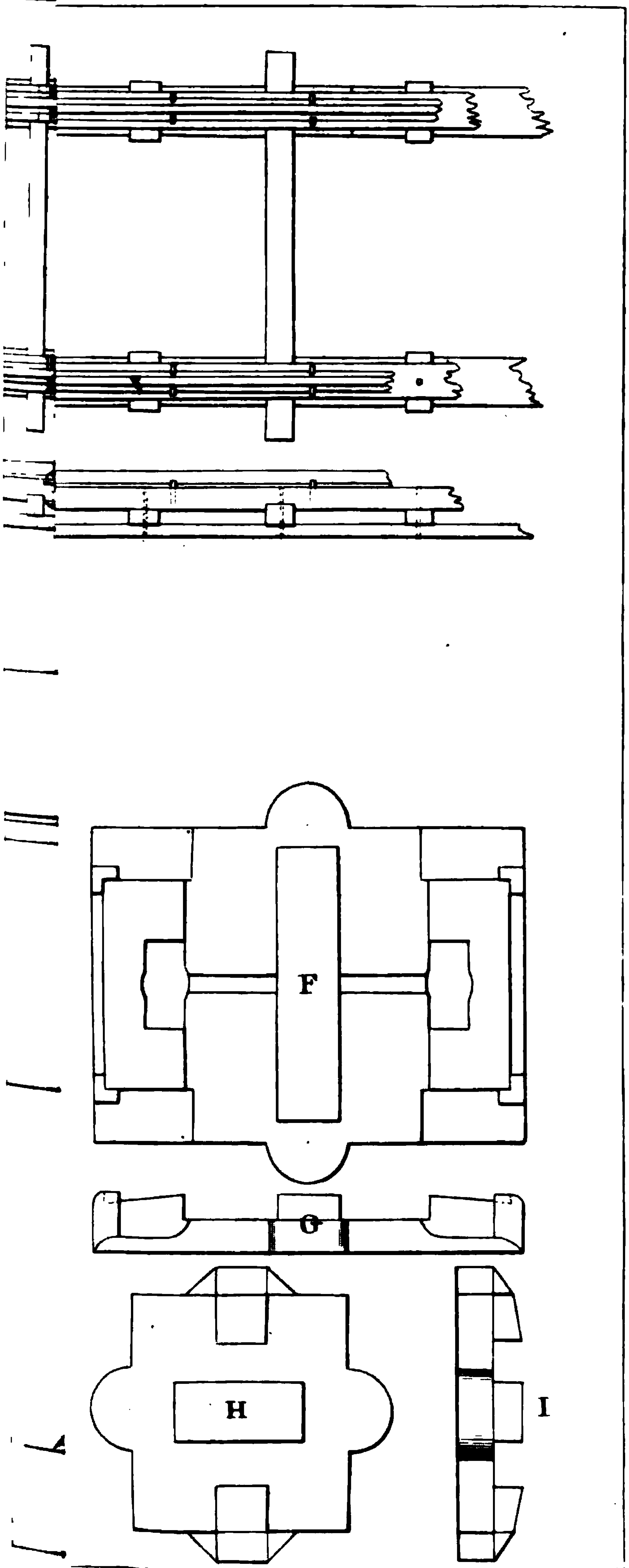
Baltimore, Md., Feb. 1, 1842.

Remarks upon the above. By ELLWOOD MORRIS, C. E., *one of the Collaborators for the Department of Civil Engineering.*

We invite attention to the foregoing plan of Railway superstructure, as embodying in a great measure, the experience acquired by the railway practice of the country.*

In 1838, Messrs. Knight and Latrobe, the distinguished Engineers of the Baltimore and Ohio Railroad, were specially commissioned to visit the most important railways in the United States, with the view

* From an inspection of the railways of general trade, which have been the longest in use, the writer is strongly disposed to conclude, that it will eventually be found advisable in such railroads as carry a very heavy traffic, and the earthworks of which have acquired the requisite stability, to lay the superstructures in *a bed of concrete*, as has been suggested in the London Mechanic's Magazine; the expense of which, in such cases, would probably be compensated by the additional smoothness of surface, and freedom from derangement, which such a foundation might fairly be expected to impart to railways.



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of availing themselves of the experience of the whole country, in framing a plan for a new track, then about to be laid between Baltimore and Federick, to replace the original superstructure, of which the wood work had decayed and required renewal, and *the stone* continuous bearings had ceased to give satisfaction.

The results of the observations of these Engineers, were reported to the Directors of the Baltimore and Ohio Railroad Company, in an able and elaborate memoir, describing minutely the rails, fastenings, &c., of the most conspicuous railroads then actually in operation, or nearly completed; they discussed in detail the merits of the various plans of railway, which came under their observation; and ultimately recommended a superstructure having a sub-sill and cross-ties, surmounted by a rolled iron H rail of 50 lbs. to the yard, in lengths of 18 feet, with angular joints, and for which the cross-ties formed isolated bearings of 2½ feet asunder, from centre to centre, except at the ends of the bars, where the bearings were made but 1½ feet, conformably to Barlow's experiments; this superstructure was designed to be embedded in a broken stone ballasting, of one foot deep; and many miles upon this plan were laid in 1839, and have since been in constant use.

A number of railways have been laid down without any *sub-sills*, and if they could be properly dispensed with, it would certainly be desirable; but it is found in practice that detached sleepers, resting either on the grade directly, or on broken stone, settle so unequally, as soon to render the road dangerously rough; and hence, a strong feeling in favor of sub-sills to equalize the settlement of superstructures, has grown up amongst Engineers, and it is certain at least, that they are used upon the best railways in the country.

Though there are, of course, some variations in the details of the fastenings, &c., the superstructure above described differs from that adopted in 1838—at the suggestion of the same gentlemen—mainly in two particulars:

1. In having *a continuous bearing of timber* beneath the rolled iron rail, upon which it rests throughout its length.

2. In the adoption of the U, bridge, or trough section, for the iron rail, in lieu of either the T or H patterns.

These two essential variations from the plan of railway superstructure, recommended by Messrs. Knight and Latrobe, in 1838, are fully justified, if not absolutely demanded, by the practical experience upon these points, now dawning upon the country; which at an earlier period in the history of railways, could not perhaps have been foreseen, and certainly was not anticipated.

With regard to the first point, a close observation of such of the American railroads as have been the longest in use—possessed of the

largest trade—and traveled by the heavy locomotive steam engines, which are now so common, will fully satisfy any professional man. that the alternate succession of *"rigid points and flexible spaces,"* which inevitably results from the employment of *isolated bearings*, tends to a more rapid destruction, both of the locomotive machinery and of the road itself, than is likely to ensue, where the iron edge rails are sustained upon *continuous bearings of timber* of heavy proportions; which plan has also the recommendation of having already been practically tested upon the Baltimore and Port Deposite, and Washington branch railroads in this country, and the Great Western, and London and Croydon railways in England—with satisfactory results in each of these cases, so far as the writer is informed—besides being employed upon some other important railways in America, which are now in the course of construction.

Concerning the second point, or the sectional form of the rail—we will observe that the top table of the bars, upon which the wheels run, in the T and H forms—being supported in the centre alone by a single upright stem, in thickness, about one fourth only of the width of the head—soon crushes off on one side or the other of the centre, and renders it necessary to reverse the position of the bars.

On the Baltimore and Ohio Railroad, as the writer is informed, *already* has occasion been found to reverse the position of a number of the bars (of the track laid with the 50lbs. H rails in 1839) *whose inner flanges have partially peeled off!* and upon the Columbia Railroad, which has been *but seven years in use*, rolled iron rails of the T and H forms may be seen in every stage of destruction;* and though a portion of the disintegration which may there be witnessed, is undoubtedly owing to the intrinsic structure of rolled iron, and hence can only be postponed, and not annihilated, by any change of form or

* Time was, when Engineers generally, were under the impression that rolled iron edge rails of 50 lbs. to the yard, would last from forty to sixty years, but experience is fast dissipating all such ideas, by demonstrating that the duration of rails of malleable iron is not determined by mere superficial wear, but, *by the time which it requires for a given trade rolling upon them, to disrupt the bars into their elementary laminæ*; and the present indications of experience are, that upon railways possessing an amount of trade, equal to that which annually traverses the railroad between Philadelphia and Columbia, rolled iron edge rails of the T and H forms and of ordinary dimensions, will not endure more than ten years.

That the public authorities of our state are becoming aware of the probability of this, may be inferred from the following extract taken from the late report on the condition of the Columbia railroad, made to the Canal Commissioners of Pennsylvania, by W. B. Hufnagle, Esq., the Engineer in charge of that work during the past year.

"One fact, (says Mr. Hufnagle) however, cannot be concealed, that the iron rail which forms the heaviest item in the construction of a railway, exhibits strong symptoms of coming destruction, and even now, a portion should be replaced with new iron of an improved pattern;—the laminæ of which it is composed appear to have become detached, and exfoliate

pattern; still it must be admitted, that if the top table of the rail had been so supported as to prevent it from being forcibly disrupted from its vertical stem, and thus render it subject alone to the natural exfoliations, which occur when malleable iron is exposed to a series of great rolling weights, the durability of that railway would have been essentially increased.

The sort of support to the head of the rail, which practice now shows to be necessary, is given by the double stems of the U section, and not by the single one of the T figure; consequently, it seems to the writer that, experience on existing works, demands in future ones the adoption of the former pattern, in outline at least; for it is a question which time alone can determine, whether we shall not finally come to a solid bar rail as the best; for the present, however, it will probably be the proper course to use the U rail as now rolled hollow, in which form, as it can be made as light as the T and H patterns, its superior durability will gradually cause rails of the latter figure to pass from use, and give place to those of the former pattern, unless a superior section should meanwhile be introduced.

To support these views, it would be easy to cite further examples of the decay of rails of the T and H forms; but it seems scarcely to be necessary, and upon the whole, we are disposed to conclude that the experience of the country, up to this time, indicates the propriety of adopting in future railway superstructures, *a continuous bearing of timber laid with a U rail, upon a suitable substructure,* in preference to any of the other plans now in use, most, if not all of which, seem on trial to possess fewer practical advantages.

In fine, the new superstructure of the Baltimore and Ohio Railroad, appears to combine in its plan, a sufficient provision to satisfy the most important requisites, in favor of which, the railway practice of the country has pronounced—viz:

1. That to guard against disturbance by frost or rainy weather, the superstructure ought to be embedded in a *ballasting*, entirely pervious to water, and of a sufficient depth.

2. That to prevent the track from spreading laterally, numerous *cross-ties* should be employed.

3. That to prevent unequal settlement of the *cross-ties* (which also

under the pressure of the cars, thereby requiring the rail to be reversed, or rendered useless,—this reversion has so frequently taken place that prudence would dictate the importation of at least 50 tons to supply the defective parts."

Here is a striking verification of the prediction made many years ago concerning rails of malleable iron, by W. Chapman, of Newcastle, a distinguished English Engineer, (see Wood on railroads) whose opinions were then strenuously combated by other Engineers, who must now, or soon, admit, that Mr. Chapman's anticipations *were truly prophetic.*

form detached supports for the rails or continuous bearings) *sub-sills* of wood are indispensable.

4. That to render the road more smooth, more equal in strength throughout, capable of carrying greater weights than roads of isolated bearing, and exempt from "rigid points and flexible spaces," *continuous bearings of timber* ought to be employed to carry the iron rail.

5. That the iron rail itself ought to be of the U pattern, (either hollow or solid) as superior in durability to any other known form of section, now in actual use, whilst it is very stable in position, and cheap in its fastenings when properly laid.

6. That the iron rail-bars ought to be firmly fixed at their middle parts, to cause expansion and contraction to take place, both ways from their centres.

These are the principal points to be attended to, though there are others of importance in arranging the details, which will so readily occur to persons conversant with these matters, as not to require any particular reference.

The propriety of augmenting, by any economical means, the durability of the timber of railways, is evidently of the last importance; and it appears to the writer that the process of impregnating wood with the pyrolignite of iron, by means of the aspiration of the sap of newly felled trees,—as prescribed by M. Boucherie,—furnishes a cheap practical mode of rendering timber almost indestructible; and to this process, we would solicit the attention of Engineers, and others connected with railways, in the most pointed manner.

The admirable preservative process of M. Boucherie, has recently been ordered by the Minister of the Marine, (after numerous experiments) to be applied upon a great scale to the preparation of timber for the use of the navy of France; and the "modus operandi" translated from the French periodicals, by Professor J. F. Frazer, may be found detailed at length in this Journal for 1841, to which we refer for more minute information upon this point, as well as for the record of a curious series of experiments on the protection from putrefaction, which is afforded to vegetable substances of the most destructible character, by mixture with solutions of corrosive sublimate, pyrolignite of iron, &c.

To render the description of the new track of the Baltimore and Ohio Railroad still more complete, we have below taken the quantities of the several component materials, (as furnished to us by Mr. Latrobe) and applied to them the scale of prices assumed by that gentleman, in his pamphlet upon the Z rail (as an average for the United States) in comparing the expense of sixteen different tracks of rail-

way, used or projected; (see p. 179 of this Journal for March, 1841) so that in this manner the relative cost of the plan under consideration, may be ascertained, and compared with the rest.

Estimate of the cost of one mile of single track railway, upon the plan now being constructed upon the Baltimore and Ohio Railroad, between Harper's Ferry and Cumberland, (96 miles) using the actual quantities of all materials, and the scale of prices, by which the cost of the same extent of the other railway superstructures, quoted on the next page, has been in each case calculated.

Ballasting.

950 Perches of broken stone to pass through a two inch ring.

950 Perches of ditto, to pass through a four inch ring,

1,900 Perches of *ballasting*, at 87½ cents, $1,662 50

Lumber.

				Ft. B. M.	
10,560 ft. lineal of	3 × 10	*sub-sills*	in lengths of 20 ft.	26,400	
10,560 do	4½ × 8	*continuous bearings*	do.	31,680	
7,392 do	4½ × 6	*cross-ties*	in lengths of 7 ft.	16,632	
2,112 do	3 × 6	*bearing blocks*	" of 1 ft.	3,168	
				77,880	
77,880 Ft. B. M. of *Lumber*, at $25 per M.					1,947 00

Tree-nails.

3,696 *Tree-nails*, for *ties and blocks*, 12 in. long, 1¼ in. diam.

1,056 *Tree-nails*, for *joints of bearings* 12 in. long, 1 in. diam.

4,752 *Tree-nails* at 1 cent each, average 47 52

Rails of Rolled Iron.

80 tons, in lengths of 20 feet, at $70 per ton, 5,600 00

Fastenings of the Rails.

528 *Cast iron joint chairs*, each weighing	7¾ lbs.	4,092 lbs.	
528 do *centre chairs*, do	4 lbs.	2,112 "	
528 do *bearing plates*, do	2¾ lbs.	1,452 "	
		7,656	
7,656 lbs. *cast iron fastenings* at 4½c. per lb.			344 52
1,056 *Wrought iron screw bolts and nuts* for joint chairs, weighing each 1½ lbs.		1,584 lbs.	
1,056 *Wrought iron washers* for ditto, $\frac{9}{16}$ lbs. each,		594	
		2,178	

Carried over, $9,601 54

	Brought forward,	$9,601 54
	2,178 lbs. *wrought iron bolt fastenings*, at 12c. per lb.	261 36
8,448	*Brad headed wrought iron spikes*, for middle chairs and intermediate fastenings, at 4¼ oz. each, 2,247 lbs.	
	2,247 lbs. *wrought iron spike fastenings*, at 9c. per lb.	202 23
1,056	*Zinc washers*, 10 to the lb.—106 lbs. at 10c. per lb.	10 60
	Workmanship.	
320	rods of workmanship in laying the track, at 2,75 cents, per rod lineal,	880 00
	Total per mile of single track,	$10,955 73

Such is the cost of a road upon the plan described, and with the prices assumed; but as some of these are higher than are now actually being paid by the Baltimore and Ohio Railroad Company to their contractors, the cost to that company will not probably exceed $10,000 per mile of single track, notwithstanding all the materials used by them are of the very best quality.

Comparative cost per mile of single track of several railway superstructures, compiled from B. H. Latrobe's pamphlet on his projected Z rail.

1.	New Jersey Railroad,	T rail	38 lbs.	per yard	$10,700
2.	Boston and Worcester,	T rail	38½	do	10,637
3.	Baltimore and Susquehanna,	H rail	58½	do	11,556
4.	Stonington and Providence,	H rail	58	do	11,149
5.	Long Island,	H rail	56½	do	10,587
6.	Boston and Providence,	H rail	55	do	10,352
7.	Baltimore and Ohio, (track of 1838,)	H rail	52	do	10,354
8.	Philadelphia and Reading,	H rail	45⅛	do	9,451
9.	Camden and Amboy,	H rail	45	do	9,114
10.	Newcastle and Frenchtown,	H rail	43½	do	8,736
11.	Washington Branch,	H rail	40	do	9,519
12.	Baltimore & Port Deposite,	square rail	40	do	9,428
13.	Wilmington and Susquehanna,	U rail	40	do	8,752
14.	Projected track Baltimore and Ohio Railroad,	U rail	45	do	9,927
15.	do	Z rail	45	do	9,482
16.	do	Z rail	35	do	8,169
17.	Track (of 1841) above described, Baltimore and Ohio Railroad,	U rail	51	do	10,956
					17)168,869
	Average cost per mile of seventeen tracks,				$ 9,933

As it has now been officially announced that the rolled iron edge rails of the Columbia railroad "exhibit strong symptoms of coming destruction," it is a matter of great interest to ascertain as nearly as possible the amount of trade, which has produced such a result.

With this view, the writer has carefully examined the reports of the Canal Commissioners of this State, and though we must regret that the information there made public, is not sufficiently detailed to enable us to decide the question with accuracy, still we can form some approximation to the truth.

By data obtained in the reports referred to, for the years from 1835 to 1841, inclusive, we find that:

In 1835,	1,188	Engines hauled over the road, (77 miles)	10,588	cars.
" 1836,	2,493	do	24,043	"
" 1837,	2,977	do	38,064	"
* " 1838,	3,608	do	45,364	"
" 1839,	4,239	do	52,664	"
† " 1840,	4,980	do	57,520	"
" 1841,	5,720	do	62,375	"
	25,205		290,618	

Now allowing the mean weight of the above Engines, including their tenders to have been sixteen tons each, and that each of the cars, including its load weighed three tons, (both of which are mere suppositions, the official documents not giving the tonnage) we find that the gross amount of the above traffic has been, *approximately*,

		Tons.
25,205	Locomotive Steam Engines, at 16 tons,	403,280
290,618	Cars, loaded and empty, averaging three tons,	871,854
	Probable gross tonnage, including 1841, say	1,275,134

The gross trade therefore, which has reduced the rails of this road to their present dilapidated condition, may be stated at *thirteen hundred thousand tons*, unequally distributed upon two tracks, but in point of fact chiefly carried by one.

From present appearances, it would not be an unreasonable inference, that ere the aggregate tonnage passed upon this double track railway, by the aid of Locomotive steam power, shall have reached the amount of *two millions of tons gross*, the destruction of the edge rails of rolled iron of the Wigan and other similar patterns, weighing

* Estimated at a mean between 1837 and 1839, the official report for 1838 furnishing no data.

† Estimated at a mean between 1839 and 1841, in consequence of the report for 1840 not supplying the information.

from thirty-three to forty-two pounds per yard, ***will be complete;*** or in other words, by the time that number of tons gross (with its usual distribution on the two tracks) shall have rolled upon their surfaces, the top tables of those rails will be entirely crushed off from their vertical stems, and the rails themselves rendered useless.

And it must not be forgotten in this connexion, that many miles of stone and wooden superstructure upon this same road, have already been worn out or abandoned, and hence, that our estimate of durability leans in favor of the existing rails, rather than otherwise.

Finally, as the greater part of the tonnage of the Columbia railway has probably been carried upon one track only, the experience developed in its use goes far to justify a belief, that rails of the T and H patterns, similar to those employed here, are incapable of carrying more trade upon a single track than about ***fifteen hundred thousand tons, gross weight.***

James River and Kanawha Improvement.

We learn from the seventh annual report to the Stockholders, made by Judge Cabell, the President, in December, 1841, and for which we are indebted to the politeness of E. H. Gill, Esq., Civil Engineer; that this magnificent line of transport—by which Virginia is opening through the heart of her territory a cheap route for the carriage of goods, between steamboat navigation upon the Ohio and tide-water at Richmond—is actively progressing.

The Stockholders, assembled in general meeting, have resolved to memorialize the Legislature of Virginia for such an alteration of their charter, as will allow them to dispense with the railway portage of 138 miles, hitherto proposed between the head waters of the Kanawha and the James; and to substitute in lieu of it a Turnpike and Canal improvement, consisting of a continuation eastward of their steamboat navigation, an additional distance of 116 miles, by means of the New and Greenbrier rivers—tributaries of the Great Kanawha—to Greenbrier bridge, and thence by a M'Adamized road of twenty-seven miles in length to Covington, the proposed head of the canal upon the James.

This arrangement, however, is not designed to be final, for they propose eventually to complete across the Alleghany, ***a continuous canal navigation for boats of sixty tons burden!*** and meanwhile only to use the turnpike portage of twenty-seven miles.

By the plan of 1838, the James and Kanawha improvement would consist of

	Miles.
Canal from Richmond to Covington,	239
Railroad from Covington to Loup Creek Shoals on the Great Kanawha,	138
Steamboat navigation from Loup Creek to mouth of Great Kanawha,	88
Total length,	465

By the plan of 1841, the James and Kanawha improvement would consist of

	Miles.
Canal from Richmond to Covington,	239
Turnpike from Covington to Greenbrier bridge,	27
Steamboat navigation from Greenbrier bridge to the mouth of the Great Kanawha,	204
Total length,	470

From the report of Mr. Gill, the surveying Engineer, sanctioned by the approbation of Benjamin Wright, Esq., their distinguished Engineer in chief, it appears that the estimated expense of executing the plan of 1841, does not exceed that of 1838, as formerly projected and estimated.

Inclusive of the charges of *freight, toll,* and *transhipment,* Mr. Gill estimates the expense of transporting *one ton* of agricultural productions from the confluence of the Ohio and Kanawha, to tidewater on the seaboard, by three different routes, as follows:

1. *To Richmond,* via. steamboat navigation on the Kanawha, turnpike portage, and James River Canal, $15 18

2. *To Philadelphia,* via. steamboat navigation on the Ohio to Pittsburg, and thence by Canal and two railway portages through Pennsylvania, $22 82

3. *To New York,* via. Ohio Canal, Lake Erie, Erie Canal, and Hudson river, $24 78

If these calculations should be found correct in practice, the extraordinary fact will be developed, *that the cheapest line of transportation for the carriage of heavy freight, between the valley of the Ohio and the sea, lays through the interior of Virginia.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Explosion of the Boiler of the Steamboat Citizen. By Thos. Ewbank, Esq.

TO THE COMMITTEE ON PUBLICATIONS.

On Monday, the 7th inst., as the steamboat *Citizen* was preparing to tow a packet ship from one of the docks of this city, her boiler exploded; according to some persons present it was blown into "a thou-

sand pieces." Of them a solitary fragment is all that is left, the rest fell into the water. The boiler was placed fore and aft upon the deck, and with the exception of the engine and smoke pipe, every thing connected with it, including the deck, was swept overboard. Three or four persons were wounded, two seriously, but none killed.

Supposing you might wish to add this explosion to the list kept by the Institute, I have sent the annexed sketches of the boiler, taken from plans in possession of the maker. It will be seen that its construction was similar to that of the Ohio, Gibbon, and New England. It was made of one quarter inch American iron, was about three years old, and had recently been thoroughly repaired. The *immediate* cause of the disaster is said to have been a deficiency of water. The engine was not in motion at the time. The usual strength of steam employed was fifteen inches; but on some previous occasions it had been raised to forty inches. The Engineer was a fresh hand, having been on board but a few days. From the effects produced, there can be little doubt that the steam was pretty *high;* and from the construction of the boiler and lack of water, the vertical flue within the steam chimney was most likely overheated and collapsed.

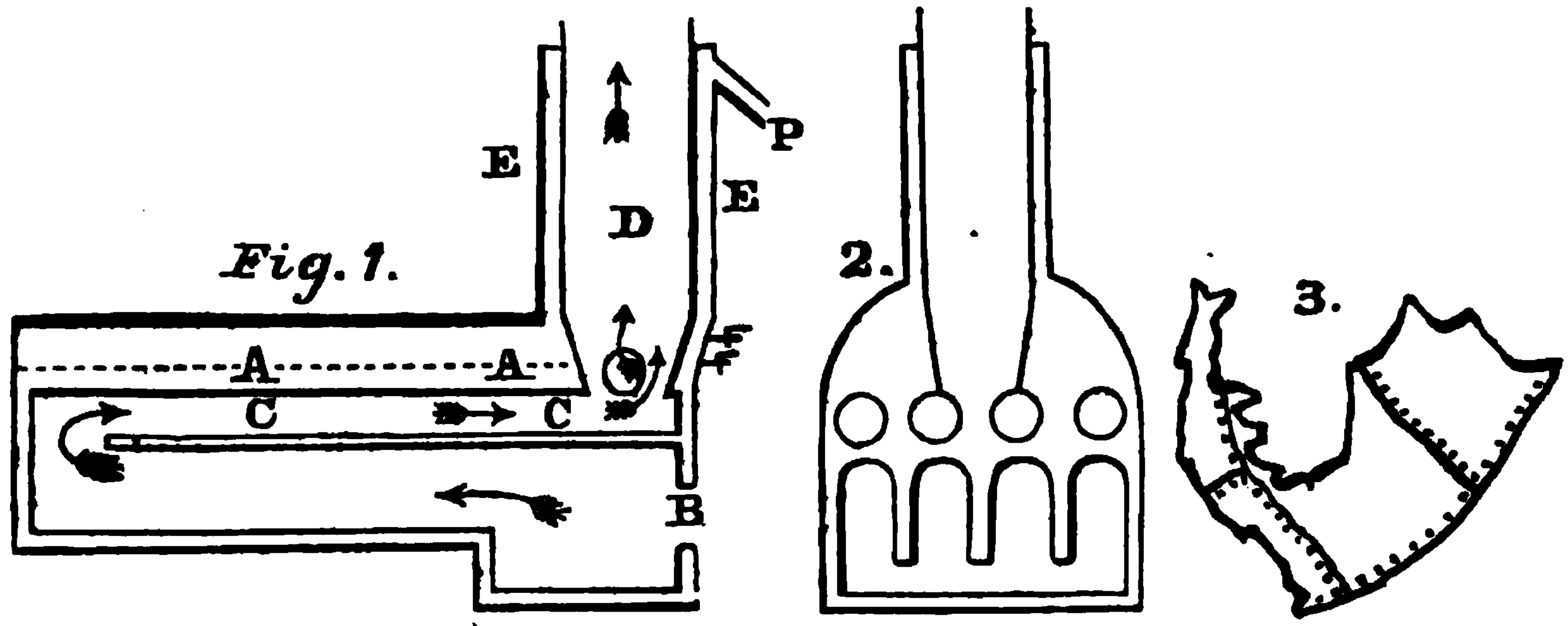


Fig. 1, is a longitudinal section. B, one of the openings for the fire doors. C, C, a horizontal flue terminating in the vertical one D, which was surrounded by the steam chimney E, E. The arrows show the direction of the smoke and flame. A, A, the water line. P, the steam pipe. There were four return flues all terminating in the vertical one.

Fig. 2, a section across the front end of the boiler.

Fig. 3, the only part of the boiler left. It does not exceed five or six feet in any direction. Some patches are on it and part of two new plates, recently put in. No part seems much worn. Two or three interior braces remain attached. The boiler was about sixteen feet long and eight feet wide. The horizontal flues were cylindrical and about sixteen inches diameter.

This is another proof of the correctness of the opinion of the Committee on Explosions respecting such boilers, and I am afraid many more will yet have to be recorded.

Very respectfully,

THOS. EWBANK.

New York, February 10th, 1842.

Explosions in Smelting Furnaces.

Translated for the Journal of the Franklin Institute, by Prof. Jno. F. Frazer.

The Annales des Mines, for January 1841, contains an interesting note upon certain explosions which have taken place in smelting furnaces, in the department of Ardennes, while employing the hot blast with baked wood.

Five explosions, of which three were very serious, took place in the course of three years; the last four occurring in rapid succession. Of these five, the last two are described in detail.

At the furnace de la Commune, on the 18th December, 1840, during the evening, half an hour after the casting, a current of gas rushed violently from the lower part of the furnace above the crucible. A loud detonation was heard. Two men who happened to be in the direction of the current were thrown down and burned. Three other workmen were greatly injured. The buildings connected with the establishment were set fire to. Upon examining the circumstances of the furnace before the explosion, it was found that the apparatus had been working irregularly for eight days previously, that the charges descended by successive falls, and out of forty or fifty that were thrown in in the twenty-four hours, four or five presented this irregular action. Each sudden descent was accompanied by a jet of gas which rose higher than usual above the throat.

During this period of eight days, the embrasure of the tuyere was completely closed, as has been for some time customary in many establishments.

A few hours before the casting which preceded the accident, the iron being completely gray, about 250lbs. of ore were thrown in by the tuyere, at different intervals, in order to whiten it.

An hour before the casting, there came a slag, very fluid, black, and charged with oxide of iron, which generally indicates a fall of the ore. At this time, the tympe was closed preparatory to casting, and for this purpose the crust of slag was suffered to harden. Nothing peculiar was observed at the tuyere; the blast was strong and steady; the casting was made. The three openings for casting, are disposed vertically. The middle one was opened and the iron run out—the same was done with the lower, and the crucible emptied within a few pounds. After a few minutes, when they wished to close completely the middle orifice, by pushing back the slag which had accumulated in contact with the plate, and introducing a clay plug, they again obtained a copious issue of iron.

A quarter of an hour afterwards a new charge was thrown into the furnace, this descended rapidly: a second was thrown upon it. The flame issued from the throat with great velocity and rose very high. It was then that the flames were perceived in the crevices of the furnace throughout its whole height. Gas entered by the tuyere, and escaped, burning, from the mastic-joints of the air-pipes. The crucible being entirely closed, the flames did not shew themselves at the tympe.

A few moments before the accident, the founder thought that he perceived that the nozzle of the air-pipe was obstructed. He thought that the slag had accumulated too high upon the iron, and went to the tympe to break the hard crust. As soon as he had withdrawn his poker, he perceived a powerful current issuing from the opening which he had made, and hurried to the flood-gate in order to diminish the velocity of the wheel, and consequently the quantity of air—the explosion took place before he reached it.

The gas, issuing from the narrow orifice which the founder had made, projected before it both iron and slag. The crucible was emptied, and the ground covered an inch deep with slag. The gas knocked down the workmen, who fell in the midst of this red hot mass, and at the same time covered them with fused iron and cinder. At the throat nothing remarkable was seen; from 100 to 120lbs. of ore and charcoal were thrown out of the furnace. By this explosion, the air-tubes were broken, and the air ceased to enter the furnace. At three o'clock in the morning, there were about six charges short, the most of which had been thrown out of the tympe. The furnace was then filled with charcoal and closed. Two days afterwards it was again put into action, after every thing had been repaired. When I visited it, it was working very well; the charges descended regularly and without sudden falls. They were working with open tuyeres. When I inquired into the behaviour of the furnace during the two months preceding the accident, I found that before the period of eight days, which has been described, a cooling had taken place in the apparatus. The slag had got into the tuyere and diminished its section; the quantity of air introduced into the furnace was less than usual. Not more than thirty charges were introduced within the twenty-four hours, in place of fifty. They had worked for nearly two months, without detecting this obstruction, finally it was discovered, and things restored to their proper condition.

The accident at the furnace de la Fade happened three weeks after that which we have described, but no one was injured by it. A powerful explosion took place, not by the tympe, but by the throat, upon the eighth of January, after the evening casting. M. Lagard, the proprietor, to whom I had communicated the result of my observations at the other furnace, desiring to examine whether any obstruction had taken place in the furnace, suffered it to cool.

The hot air apparatus had required repairs, and the furnace had been working for several days with the cold blast. The accident happened three days after the resumption of the hot blast—thirty-six hours before the accident the charges descended more rapidly than usual; and upon the day of the explosion, (which took place at five o'clock, in the afternoon,) from eleven until one o'clock, the filler could no longer keep pace with the working of the furnace. He was assisted by another, and four charges were introduced in succession. With this exception, up to the moment of casting, the furnace worked steadily. During this period also, an alteration was made in the charge. The charge of baked wood was increased to five-sixths in place of four-sixths, which had been before used, and the proportion of charcoal

was proportionally diminished. At about half-past four o'clock, in the evening, the gases at the throat were peaceable and their flow feeble. A minute before the explosion, a projection took place at the tuyere (the embrasure had always remained open;) the gases which enveloped the hot air apparatus detonated, and a current of gas issued from the tympe. The projections then began from the throat, and lasted for nearly two minutes. The furnace was almost entirely emptied. At this time, also, the flames issued from the crevices and interstices of the masonry.

Upon an examination of the interior of the furnace, there was found no trace of any permanent obstruction, by semi-fused masses cemented to the inner walls of the furnace.

Both these furnaces were similar in their dimensions; both worked easily fusible ores in fine grains, yielding about forty per cent. of cast iron; both used as the combustible, a mixture of charcoal and baked wood (or rather dried wood, for it rarely loses more than thirty per cent of its weight.)

M. Sauvage, the Engineer, to whom we owe this account, attributes these explosions to the evolution of gases from the wood, within the cavities which form in the furnaces during the irregular action described. The intense heat finally gives to these gases sufficient tension to burst suddenly the opposing barriers, and thus the explosions take place.

An account of a similar accident which occurred upon the 24th of December, 1840, at the furnace of Vanvey, Department Côte d'Or, is given by M. de Nerville. It would seem that in this case, the effect was due to the very irregular action of the hot-air blast, which was heated only by the combustible gases conducted from the furnace throat. The heat given to the blast must consequently vary materially with the quantity of gas issuing from the furnace.* The explosion took place from the tympe.

"The examination of the facts which preceded and followed this unfortunate accident, does not permit us to doubt, that the projection of the matters contained in the crucible was solely due to the fall of a large mass of the ore not yet deprived of water, upon the liquid iron and slag. A vault had formed in the furnace, and that there existed a large empty space below it, is evident from the fact that after the accident, the ore and charcoal contained in the furnace was so thrown down, as to present at the throat a depression of nearly six feet. It may easily be conceived that the fall of such a mass into the crucible would force out iron and slag, and cause the instantaneous formation of steam."

* The apparatus, arranged at the tunnel-head, to collect the gases, presented, moreover, the disadvantage of preventing the proper arrangement of the ore in the furnace, which instead of being evenly distributed, was piled up around the walls.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Strength of Iron Wire at a low Temperature.

The following experiments were made with iron wire $\frac{1}{11}$ inch in diameter, subjected to direct strain:

			At 50 Fahr.		At Zero.
1st	experiment	broke with	215 lbs.	-	214 lbs.
2d	"	"	210 "	-	200 "
3d	"	"	212 "	-	206 "
4th	"	"	200 "	-	204 "
5th	"	"	210 "	-	218 "
6th	"	"	208 "	-	226 "
7th	"	"	218 "	-	200 "
8th	"	"	210 "	-	204 "
9th	"	"	224 "	-	228 "
10th	"	"	216 "	-	206 "
11th	"	"	216 "	-	220 "
12th	"	"	226 "	-	202 "
		Mean,	214	Mean,	211

John M. Batchelder.

Saco, Maine, Feb. 24th, 1842.

Physical Science.

Notice of a Spiral Magnet, by which Secondary Currents may be demonstrated in the body of the Magnet. By Chas. G. Page, M. D., *Washington, D. C.*

More than three years since, while investigating the action of *closed* secondary currents, I was led to the conclusion that these currents must be developed in the body of the magnet itself, as well as in the coils of metal surrounding the magnet. (See Silliman's Journal, vol. 35, No. 2, page 255.) Prof. Henry, engaged about the same time in a similar train of investigations, had arrived at the same conclusion.

We had both, however, been anticipated by the conjectures of Prof. Ettinghausen, of Vienna. Since that time the existence of these currents has been regarded only as a matter of reasonable inference, and I know of no attempts to elicit and demonstrate them by the common tests. In the experiments above alluded to, I failed to detect these currents, from the want of a delicate Galvanoscope; but the magnet about to be described, affords currents of sufficient magnitude to be appreciated by shocks and bright sparks.

The magnet *m*, fig. 1, consists of a long sheet of very thin iron, rolled up in the form of a cylinder, and covered with three layers of insulated copper wire, the ends of which are soldered to the single wires *a*, *b*, for the purpose of communication with a galvanic battery. A sheet of paper is rolled up with the sheet of iron to insulate the several turns of the spiral. The wire *c* is soldered to the middle of the outer edge of the sheet; the wire *d* is also connected with the outer edge. The wire *e* is connected with its inner edge. Fig. 2, is an end view of the magnet exhibiting its spiral turns, with a fold of paper between. When the wires *a* and *b* are connected with the poles of a galvanic battery, the inclosed sheet of iron becomes a strong magnet. When the galvanic connexion is broken, a brilliant spark occurs, showing a power in this respect, superior to that of a solid bar of iron. If the ends of *d* and *e* be joined, a momentary current is obtained both at the completion and the rupture of the galvanic circuit. If *e* and *c* be joined, the current is much stronger than from *d* and *e*. It appears from this, that the wires *d* and *e* conduct the currents from only a single transverse section of the magnet, while the currents from *e* and *c* are constrained to deviate from their natural course, viz. at right angles to the axis of the magnet, and take an oblique direction from one angle of the sheet to the middle of the opposite edge. The direction of these currents I have ascertained is in conformity with the law of secondary currents, as follows:—The initial secondary is in opposition to the primitive current, the terminal secondary in the same direction with the primitive.

Description of a new plate, or quantity, Helix, for Electro Magnetic Apparatus. By Chas. G. Page, M. D., *Washington, D. C.*

The design of the new helix, is firstly to obtain a maximum of magnetic influence, by surrounding an iron bar with the greatest possible number of circumvolutions of conducting metal within a given space, and to bring those conducting circuits as near as possible to a direction at right angles to the axis of the magnetic bar.

Secondly, the plate helix affords a means of modifying magneto-electric currents, so as to obtain the maximum of their magnetizing influence. I have therefore called this a quantity helix, to distinguish

it from helices of wire, in which the magnetizing property of the currents diminish in a certain ratio to the extent of wire employed.

When a magnetic bar is to be covered with copper wire wrapped with silk or cotton, it is evident that the *double* thickness of the insulating material, increases the obliquity of the wire to the axis of the magnet, besides occupying space which should be given to the conducting metal. The round form of the wire also, necessarily involves much waste room. The conditions requisite to the full economy of magnetizing power seem to be well answered by the plate helix. *a*, fig. 2, represents one of the plates of which the helix is composed. It is an annular plate of copper, about three inches in diameter, the opening in the centre being from three quarters to an inch in diameter, to admit the magnetic bar. The plate is cut open at *e*, and one of these cut edges is soldered to the edge of a similar plate, and thus the series continued to any extent desired. Upon the upper surface of each plate a piece of thin paper of the same size and form is fastened with varnish, for the purpose of insulation. *b* represents the helix with the copper wires *c* and *d* attached to its extremities. I have not yet fully ascertained the value of this helix, but from the experiments already made with it, am confident it will answer my expectations. It magnetizes powerfully, gives brilliant sparks, and will be a valuable instrument for exhibiting the magnetic effects of mechanical electricity, as it can be stretched open to an extent which will not allow the electricity to pass from one plate to another, except in the direction of continuity.

Franklin Institute.

The Annual Meeting of the Institute was held at their Hall, January 20th, 1842.

THOMAS FLETCHER, Vice President, in the Chair;

GEORGE W. SMITH, Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

Donations were received from the Hon. Charles Brown, Member of Congress; the Young Mens' Mercantile Library Association, of Cincinnati, Ohio; Prof. Alex. Dallas Bache, Jno. D. Koecker, John White, Charles B. Trego, Prof. Walter R. Johnson, Charles Ellett, Jr., A. D. Chaloner, M. D., Henry R. Campbell, the Select and Common Councils of the City of Philadelphia, Andrew Fountain, A. Pardee, Zebeelon Parker, of Newark, Ohio; Calvin Olds, of Marleboro', Vt., and from the Estate of John Ronaldson, Esq., deceased.

The Corresponding Secretary laid on the tables the periodicals received in exchange for the Journal of the Institute.

The annual report of the Board of Managers was read and accepted, and referred for publication.

The Treasurer presented his report of the funds for the last quarter, and also a statement for the year ending December 31st, 1841—which were read and accepted.

Mr. Henry R. Campbell, from the Committee of Tellers of the annual election for Officers and Managers of the Institute, for the ensuing year, (appointed at the preparatory meeting this day,) presented their report of the result of the election, when the Vice President declared the following gentlemen duly elected:

Samuel V. Merrick, President.
Isaiah Lukens, Thomas Fletcher, } Vice Presidents.
Isaac B. Garrigues, Recording Secretary.
Alex. Dallas Bache, Corresponding Secretary.
Frederick Fraley, Treasurer.

Managers.

Abraham Miller,	Henry D. Rogers,
John Struthers,	Ambrose W. Thompson,
Matthias W. Baldwin,	George Taber,
John Agnew,	Thomas U. Walter,
John Wiegand,	John H. Towne,
Samuel Hufty,	James Hutchinson,
John C. Cresson,	Edwin Greble,
Andrew M. Eastwick,	David S. Brown,
Isaac P. Morris,	Paul W. Newhall,
Charles B. Trego,	Thomas S. Stewart,
John S. Warner,	William B. Fling,
William Hart Carr,	Joseph Yeager,

(Extract from the minutes.)

Thomas Fletcher, *Vice President.*

George W. Smith, *Rec. Secr'y., P. T.*

Eighteenth Annual Report of the Board of Managers of the Franklin Institute, of the State of Pennsylvania, for the promotion of the Mechanic Arts.

The Board of Managers beg leave to present their eighteenth annual report:

On retiring, it becomes the duty of the Board to render an account of their proceedings during the past year. The details of the operations of the past year must determine whether on the retrospect we can perceive a steady advance in the primary objects of the Institute. The Spirit of the Age is onward, and although there has been, and is much to embarrass and depress it, in which the Institute has largely shared, yet we think we see around us a sure guarantee, that our future course must be onward, in imparting knowledge in the various *able* modes employed by the Institute, and thereby usefulness to society and the world.

The great increase of Lectures by the various Associations, who have followed the example of the Institute in this respect, would naturally have led the Board to expect a decrease in attendance upon those of the Institute. This has, however, not been experienced; and they are fully satisfied, that could the accommodations for the classes be enlarged, the attendance would be much increased.

The Professors of the Institute have fully sustained the high opinions that have been expressed of their Lectures, and it is but justice to acknowledge the obligations, under which the Board and the Institute are placed to them.

The courses for the season are in progress as follows:—General Chemistry, on Monday evenings, by Prof. John F. Frazer. Mechanics and Natural Philosophy, on Wednesday evenings, by Prof. John C. Cresson. Chemistry as applied to the Arts, on Friday evenings, by Prof. James C. Booth. Prof. Thomas U. Walter has completed a course on Architecture, occupying Thursday evenings.

In addition to the above, Prof. Frazer has volunteered a course on Geology, which now occupies the evenings of Thursday. Doct. W. Beck Diver is delivering a course of Lectures on China, on Saturday evenings; by this arrangement, there are five courses of Lectures in each week now in progress. The Board have also to report that S. S. Halderman, Esq., has kindly volunteered to deliver a few Lectures on Zoology.

Under its new organization, the Committee on Publications have succeeded in adding very considerably to the interest of the Journal, and much praise is due to the gentlemen who have so liberally consented to act as Collaborators, and who have so freely contributed their time and labour to enhance the value of this publication. It would be a source of great gratification to the Board, could they note as much in the extent of its patronage, (particularly from the members of the Institute) as they can in its merits.

From the Committee on Science and the Arts, we learn that the number of subjects or inventions connected with Mechanics and the useful Arts, examined by that Committee through their Sub-Committees, during the past year, is seventy-three; of these, thirty remained from the year 1840, and forty-three were new; but twelve subjects remain undisposed of from the year just past.

Four medals and premiums have been awarded to ingenious inventors from the Scott's Legacy Fund, under authority from the City Councils. By a recent ordinance, the award of these medals and pre-

miums is continued with the Managers of the Franklin Institute, for a further period of seven years.

The Cabinet of Minerals belonging to the Institute continues to receive attention, being properly classified and arranged, and is constantly increasing by the addition of new specimens received as donations, or in exchange.

At their stated meeting in November, the Board enlarged the committee, having charge of this department, and authorized a division of the committee into two branches; one to have cognizance of such matters as relate more particularly to *Geology*, while the other, as heretofore, will attend to *Mineralogy*.

The Geological branch of this committee have commenced the arrangement of a Cabinet of Specimens, illustrative of the Science of Geology, in a room which has been appropriated and fitted up for this purpose, and which, with some further extension of shelves and cases, will be sufficient for the reception of an extensive suite of specimens.

It is believed, that from the resources already within the reach of the committee, together with such aid as they expect to receive hereafter, such a collection will be formed as will be creditable to the Institute, and highly instructive to those of our members who are desirous of studying this interesting branch of useful knowledge. As a means of further increasing this Cabinet, it is hoped that such of the members as possess, or may obtain, specimens of rocks, fossils, and minerals, either useful or curious, will be willing to contribute their aid towards rendering the collection still more complete and extensive.

Of the meteorological instruments made under the direction of the Committee on Meteorology, each of the counties of the State has been supplied with a set, except three. This omission is occasioned either by a difficulty in getting the instruments transported, or in procuring suitable persons to volunteer to take charge of them. From twenty-six to twenty-eight counties make regular monthly reports, and these counties being distributed in every part of the State, afford ample means of estimating the modifications of climate and other atmospheric changes in the various portions of our Commonwealth.

In addition to the reports received from our counties, a number are regularly addressed to the committee from gentlemen interested in the subject, residing in various sections of the Union.

A table of means from the reports, furnished by observers, has been regularly published monthly, since January 1839.

Of the original appropriation furnished by the State for Meteorological purposes, the balance on hand, December 31st, 1841, amounts to $429.84.

The monthly conversation meetings, under the care of the committee on monthly meetings, continue to attract the attention of the members of the Institute. It is believed that the usefulness as well as the interest of these meetings, may be considerably extended by an increased exertion on the part of the members of the Institute. As the committee is now organized, every member may add to the means of instruction.

The committee on the Cabinet of Models are steadily increasing the

collection under their charge, and have them so arranged, that they can be examined at any time by the members. The rooms are much frequented by strangers visiting the city.

The collection under the charge of the committee on the Cabinet of Arts and Manufactures, is yet in its infancy; but the committee have succeeded in procuring a very valuable and interesting collection of specimens of the progress of the Arts. As it is intended to embrace all the branches of manufactures, the attention of the members of the Institute is particularly requested to furnish specimens from their establishments, as well as from other sources.

As the Institute for several years past, have been in the practice of holding their exhibitions of American Manufactures, but once in two years, the committee on Premiums and Exhibitions during the past year have not had any special business to claim their attention.

The Library committee have devoted their attention to their appropriate duties, and during the past year, the increase has been by purchase, seventy-six volumes; donations, 126; exchange, 119; in all, 321 volumes.

The Drawing School, under the superintendence of Mr. William Mason, is extending the benefits to be there obtained to forty scholars. The well known ability of the gentleman, to whom this department of instruction is committed, needs no comment from the Board.

In the death of our late lamented President, James Ronaldson, Esq., which occurred on the 29th day of last March, the Institute lost a much valued friend.

During the past year eighty-five new members have been elected; 152 have resigned, and as near as can be ascertained, ten have deceased.

The following gentlemen have become life members:—James Crissey, Thomas Betton, M. D., W. J. Lewis, Wm. Hemble, Thos. Hunt, Wm. F. Geddes, George Snider, J. C. Montgomery, S. C. Henszey, George Taber, Jas. T. Allen, George W. Cross, and John G. Clark.

James H. Bulkley, *Chairman.*

William Hamilton, *Actuary.*

Minutes of the Board of Managers.

At a meeting of the Board of Managers, held January 26th, 1842,

Frederick Fraley, Esq., was elected Chairman of the Board for the ensuing year; and

Messrs. John S. Warner, and Edwin Greble, Curators.

At a subsequent meeting, the following Standing Committees for the ensuing year were appointed:

On the Library.

Thomas S. Stewart, *Chairman.*	Joseph Yeager,
Ambrose W. Thompson,	Alfred L. Elwyn, M. D.
Isaac P. Morris,	Robert Lindsay,
Thomas U. Walter.	

On Geology and Mineralogy.

Charles B. Trego, *Chairman.*
Isaiah Lukens,
Abraham Miller,
Samuel Hufty,
Henry D. Rogers,
James C. Booth,
John F. Frazer,
Richard C. Taylor,
John H. Towne.

On the Cabinet of Models.

Isaac P. Morris, *Chairman.*
John Agnew,
Andrew M. Eastwick,
Thomas S. Stewart,
William B. Fling,
John M'Clure.

On the Cabinet of Arts and Manufactures.

James C. Booth, *Chairman.*
Charles B. Trego,
John Struthers,
John H. Towne,
Edwin Greble,
John F. Frazer,
Joseph Saxton,
James C. Hand,
Lewellyan S. Haskell.

On Publications.

John C. Cresson, *Chairman.*
Alex. Dallas Bache,
Samuel V. Merrick,
Matthias W. Baldwin,
Isaac P. Morris.

On Premiums and Exhibitions.

Samuel V. Merrick, *Chairman.*
John C. Cresson,
Alex. Dallas Bache,
Thomas Fletcher,
John Struthers,
John S. Warner.

On Instruction.

Alex. Dallas Bache, *Chairman.*
Frederick Fraley,
John Wiegand,
Charles B. Trego,
Paul W. Newhall.

On Monthly Meetings.

Roswell Parke, *Chairman.*
John C. Cresson,
Robert Hare, M. D.,
Thomas Fletcher,
William H. Carr,
James Hutchinson,
George Taber,
Joseph Saxton,
Albert W. Metcalf.

On Meteorology.

G. Emerson, M. D., *Chairman.*
John C. Cresson,
Roswell Parke,
Henry D. Rogers,
Owen Evans.

On Finance.

Samuel V. Merrick, *Chairman.*
Frederick Fraley,
Matthias W. Baldwin,
David S. Brown,
John Wiegand.

Managers of the Sinking Fund.

Samuel V. Merrick, *Chairman.* David S. Brown,
Frederick Fraley, Paul W. Newhall.
Matthias W. Baldwin,

Auditors.

Isaac B. Garrigues, *Chairman.* William Hart Carr.
Ambrose W. Thompson,

(Extract from the minutes.)

FREDERICK FRALEY, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

COMMITTEE ON SCIENCE AND THE ARTS.

Baxter's Hot Air Engine.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a plan for a Hot Air Engine, invented by Mr. Morris Baxter, of Marshall county, Illinois, REPORT:—

That Mr. Baxter proposes to obtain a moving power from the expansive force of air, heated in suitable reservoirs, and allowed to act on pistons after the manner of steam. So far as the committee can learn, there is no reason to doubt that the idea of this *hot air* engine is original with Mr. Baxter, and that he supposed himself to be the first discoverer of a new source of power. The first duty of the committee was to disabuse him of this error, by shewing what has been proposed by Dr. Arnott, and other inventors of similar schemes.

This ungracious task being accomplished, the present inventor desires the opinion of the committee as to the merit of his peculiar mode of applying the principle to practice. The only peculiarity suggested in this case, is that of condensing the air into one-quarter, or any smaller fraction, of its natural volume, before subjecting it to heat. By this means it is supposed that less heat will be required to raise its temperature through any given thermometric range, that the bulk of the machine will be materially reduced, and that, possibly, some gain might arise by using a series of expansions, beginning with a tension of six or eight atmospheres, instead of two or less.

There can be no doubt, that if this species of engine should ever be brought into use, some advantage would arise from the greater compactness attained by using the air in a condensed state, and that some small saving of heat would be caused by the diminished bulk of the solid parts of the engine; but the experiments of M. M. De la Vive and Marcet, shew that the capacity for heat of all elastic fluids, increases with their density, and that consequently, a pound of air will require the same heat to raise its temperature through any range, if it occupy but one cubic foot of space, as it would if expanded to 100 feet.

The remaining part of the enquiry is whether the effect produced by the elastic expansion of a gas is proportional to its initial density, or varies according to some function of the density differing from a sim

ple proportion. This question resolves itself into the mathematical determination of the sum of all the ordinates representing the elastic force at different periods of expansion, which is equivalent to the area of the logarithmic curve. A member of the Institute, well known for his mathematical acquirements, has kindly furnished the committee with a solution of this problem, in which it is demonstrated, that from the constancy of the subtangent of the logarithmic curve, the area of the curve is simply proportional to the value of the ordinate representing the density, and therefore, no gain can arise in this respect from using air condensed previous to heating.

By order of the Committee.

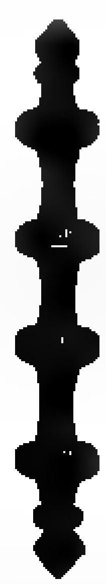
February 10*th*, 1842. WILLIAM HAMILTON, Actuary.

Shepherd's Cast Iron Butt Hinges.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination Cast Iron Butt Hinges, invented by Mr. Thomas Shepherd, and manufactured by Mr. William Hart Carr, of Philadelphia, Pennsylvania, REPORT:—

The hinges submitted to the inspection of the committee comprised all the principal forms used in building. They are composed entirely of cast iron, and in this respect, differ from the kinds fabricated abroad; these latter hinges being generally furnished with pins or spindles of wrought iron. The hinges made by Mr. Carr are cast into com-

b *a* *c*



plete form by three operations: the first of these is to form the spindle *a*, which is effected by casting rods of metal into suitable lengths for use, which rods resemble a string of obtuse cones, joined together by their apices and bases. These are broken into proper lengths for the hinges intended to be cast, and by an adjustment of the mould, and filling up the interstices between the cones with sand, one half of the hinge *b*, is cast over the proper portions of the spindle, leaving the protected parts thereof uncovered by the flow of melted metal. The remaining half is then cast in a mould, adjusted so as to permit the introduction of the portion already fitted to the spindle, and by the application of a

suitable paste, the melted metal poured into the mould to complete the hinge *c* is prevented from adhering to those parts which are required to form the opening and turning parts of the hinge. They are then ground and finished in the usual manner for market.

From some trials of the strength of the hinges made by Mr. Carr, as compared with the best article of English manufacture, particularly in reference to the ability of the spindle to bear a blow or strain, the committee is of opinion, that they are fully equal in those respects to the foreign article.

And from the fact communicated to the committee, that they can be furnished at as low a price as those coming from abroad, they conceive the ingenuity and skill evinced in their fabrication to be worthy of high praise.

The whole process of manufacturing the hinges appears to the committee to be new, and to furnish by its results an article extensively useful in buildings of a very substantial character; and in form and style, very creditable indeed to the gentleman who have embarked in its manufacture.

By order of the Committee,

William Hamilton, Actuary.

February 10*th*, 1842.

Corrosion of Iron in Steam Boilers and Stove Pipes.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Corrosion of Iron in Steam Boilers and Stove Pipes, where Anthracite is employed as fuel, REPORT:—

That they have gathered such information as lay in their power from those who have witnessed the corrosive action, and combined it with their own observations.

It appears that stove-pipes are frequently corroded in the course of a year or two, where they are not taken down or cleansed subsequent to their employment through the winter season. An instance is known in which forty feet of pipe were corroded and rendered a perfect colander in the course of two years. Nor does it appear always as a necessary condition that the place should be damp, although this is the case in a majority of instances, for in the corrosion just noticed, the proprietor stated that the stove was very dry. The corrosion rarely happens in an upright pipe, but usually in one lying horizontally, for where such corrosion had already commenced it was said, in one instance, to have been obviated by giving the pipe a slight inclination. Where it takes place in an upright pipe, it may arise from the flowing down of corroding matter from a horizontal layer of the same.

The same kind of corrosion is observable in steam boilers in which anthracite is employed as fuel, and not in those in which bituminous coal is used. That it does not arise from the intensity of the heat is shown from the fact, that it is greatest in the boiler-flues which lie horizontally at a distance from the fire. A corrosion is sometimes ob-

served near the top of the smoke pipe in steamboats, but this may be attributed to the alternate action of heat, cold, air, and moisture.

It would appear then, that the corrosion is caused either by the vapors arising from the combustion of anthracite, or from matter carried up mechanically by the draft; or from both combined. That it does not proceed from uncondensable gaseous matter is proved by the occurrence of the corrosion only when a stove-pipe is no longer exposed to these vapors during the summer season, or where a boiler is cooled from intermitted fires. It does not arise from matter carried up mechanically, for this could only be ashes, and we know that the ashes of anthracite is of a dry nature; and without moisture, chemical action, or the corrosion, could not occur. It must, therefore, be produced from condensable vapors.

On examining the interior of a stove-pipe lying horizontally, whether corroded or not, we find a loose ashy deposite of a greyish brown color; and where corrosion has taken place, the greater part is condensed into a solid mass, showing that it had absorbed water. Upon fracturing the solid material, small white crystals appear under the microscope, which are generally too imperfect to admit of recognising their form. By subliming the mass, a little empyreumatic oil and water are formed, but the greater part sublimed is an ammoniacal salt. Upon testing a solution of the ashes, it shows a large content of muriate and sulphate of ammonia, the former evidently in much greater quantity than the sulphate. After complete sublimation at a red heat, the ashy matter remaining appears to be nearly pure charcoal or lamp black, with a mere trace of coal ashes. From the qualitative tests made, it would appear that the ammoniacal salts constitute at least three-fourths of the whole mass. A mere trace of iron was detected.

From this content of saline matter, as well as from its nature, we are at no loss to account for the corrosion of iron where the air and moisture add their conjoint action; but it may be doubted whether the ashy matter has the power of absorbing moisture from an atmosphere of ordinary dryness, for in dry situations, it appears that there is usually no corrosion, and in the case noticed at the commencement of the report, it may be doubted whether the stove was dry.

How to obviate the corrosive action is a more difficult point to determine, unless the very simple process be resorted to, of cleaning out stove-pipes every spring, and boiler-flues every few weeks. If the stove-pipes are required to remain standing with the sediment in them, then a previous internal coating of white lead, litharge, or red lead might probably answer the best purpose, since it would result in the production of chloride and sulphate of lead, while the ammonia would be driven off. The thin coating of these salts of lead might then prevent the contact and farther action of the ashy deposite. Experiments made at the U. S. Mint during the winter of 40—41, seem to show that a coating of lime on the interior of a pipe prevents corrosion, and it is said that a few stove manufacturers in this city are acquainted with the fact. The committee, however, in the face of these facts, are rather inclined to believe that the oxide of lead will prove more efficient, since the sulphate of lead is a wholly inert salt, and the chloride

nearly insoluble, while the sulphate of lime is somewhat soluble, and the chloride of calcium very soluble, and therefore likely to produce corrosive action eventually. Still the operation of whitewashing is the simplest mode of obviating corrosion, and may be repeated at intervals.

The content of chlorine to such an extent as is developed by the above chemical examination, is interesting in a geological point of view, since it has not hitherto been found in chemical examinations of anthracite. Prof. H. D. Rogers, in 1836, pointed out the fact, that where heaps of refuse matter were burned near the coal mines, ammoniacal salts, and among them muriate of ammonia are sublimed, and may be found among the ashes. Now we know that saline waters are obtained from the coal measures in the western district of Pennsylvania, and moreover, it is the prevailing opinion among Geologists, that the coal series are marine deposites; we can therefore explain the origin of the muriate of ammonia in the ashy deposite arising from the combustion of anthracite, by attributing the chlorine to the presence of a trace of chloride of sodium (common salt) in the coal or its accompanying slate, or possibly in both. It is unnecessary to allude to the formation of ammonia, since it is a universal product to a greater or less extent of the dry distillation or combustion of every kind of coal.

This ammoniacal deposite is interesting in an economical point of view, since it accumulates in considerable quantity in a single season, and may be collected with facility. In one instance at least, ten pounds were removed from about eight to ten feet of pipe, which was the produce of three or four years, and hence, we may estimate the large amount that might be obtained from many hundred pipes in Philadelphia every season. It may be employed either for the manufacture of sal ammoniac by a very simple process of sublimation with a small quantity of a salt of lime, or it may be directly applied in powder or in solution to garden-soils. The influence of ammoniacal salts in promoting luxuriant vegetation has long been known, but the admirable work of Prof. Liebig on Agricultural Chemistry, has more completely developed their influence and importance. The material before us will unquestionably prove of great value to the gardener and florist, if properly applied to the soil; but it must not be forgotten that it is very rich in ammonia, and should therefore be employed sparingly.

By order of the Committee,

February 10th, 1842. WILLIAM HAMILTON, Actuary.

Baldwin & Vail's Locomotive Engine.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a six wheeled, geared, Locomotive Engine, intended for the transportation of heavy freight trains, manufactured by Messrs. Baldwin & Vail, of Philadelphia, Pennsylvania, REPORT:—

That the sub-committee appointed to examine the above mentioned engine, met upon the Columbia railroad on the 25th of January,

1842, and went with the engine out to the Schuylkill bridge, and returned with it to Broad street, drawing a train of burthen cars, the gross load being about 200 tons, which was much below the limit of the engine's power, but included all the cars that were then ready to be brought in.

The peculiarity of this engine consists in its obtaining the adhesion of the four wheels of the truck, in addition to that of the main driving wheels, without preventing the truck from vibrating so as to accommodate itself to the curves and undulations of the road. Experience upon the American roads, as far as known to this committee, proves that engines having six wheels and provided with leading trucks, move much more steadily than those with only four, and, as a partial loss of power and other injurious consequences result from the slipping of the driving wheels of locomotives, (which often occurs to a considerable extent, even when it does not prevent the engine from drawing its load, and is not noticed by the engine-man) it is very desirable to obtain the adhesion of all the wheels, without losing the advantages of a vibrating truck.

The difficulty in doing this arises from the fact, that when the engine stands on a curve, the axles of the truck wheels are not parallel to that of the main driving wheels. Messrs. Baldwin & Vail obviate the difficulty in the following manner. A pair of main driving wheels, forty-four inches in diameter, are placed behind the fire-box, as in their well-known form of engine, but the axle, instead of being cranked, is straight, and the connecting rods from the pistons of the cylinders have outside connexions;* and attached to the same wrists are other connecting rods, extending forward and giving motion to a shaft under the front part of the boiler and between the axles of the truck, which shaft is secured so as to maintain its parallelism with the axle of the main driving-wheels, at right angles to the axis of the boiler. On the middle of this shaft a cog wheel is fixed, having chilled cogs slightly rounded on the face, which, by means of two intervening wheels, give motion to others on the axles of the truck. The four truck-wheels are thirty-three inches in diameter, and the gearing is proportioned so as to make them travel at the rate of the larger wheels.

The steam cylinders are thirteen inches in diameter and sixteen inches stroke. The gross weight of the engine in running order is 29,980 lbs., which is apportioned so that 11,755 lbs. are on the two points of contact with the road behind the fire-box, and 18,225 lbs. on the four points of contact under the truck. When tried upon the Columbia railroad in the presence of the committee, the engine drew its train readily around curves of 757 feet radius, the rounded surfaces of the chilled cog gearing allowing the axles of the truck to suit themselves to the curvature of the track. The engine passed with ease around a curve of ninety degrees, having a radius of 312 feet, the train being detached, and afterwards backed itself around a curve of seventy-five feet radius without difficulty.

The engine has since been in use upon the Reading railroad, and it appears from a certificate of Mr. Nicolls, the Superintendent, that on

* This improvement is applicable to engines with cranked axles.

the 12th of February, it drew from Reading to the Columbia railroad, a distance of fifty-four miles, a train of 117 loaded freight-cars; the cars weighing 215, and the freight 375 tons, making a gross load of 590 tons. The speed when in motion being ten miles per hour.

In the opinion of the committee, this engine combines in a high degree the advantages of a vibrating truck with the use of the adhesion of all the wheels; they think it well worthy of the attention of railroad companies doing a freighting business, and believe that it will add to the deservedly high reputation of the builders.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

February 21*st*, 1842.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1840, AND JANUARY, 1841.

With Remarks and Exemplifications by the Editor.

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51. For improvements in *Valves for the Pneumatic Railway*, applicable to other purposes; Samuel Clegg and Jacob Samuda, Sidmouth street, Gray's Inn lane, Middlesex county, England, December 31.

The subject of this patent is a mode of rendering air-tight the valve which closes up the slot, through which passes the connexion between the carriages of the pneumatic railway and the piston working in the cylinder, and which is applicable to machinery in general, in which such connexion is required. These valves work on a hinge of leather attached to one side of the slot, and the other falls into a trough filled with a composition of bees wax and tallow, or bees wax and oil so compounded as to be solid at the usual temperature of the atmosphere, and fluid a few degrees above it. The valve is opened by the connexion between the piston and the carriage, or other body outside, and falls back after it has passed, and is pressed again in its place by a roller, or other body, passing over it; and this is followed by a heated body of metal, which melts the compound, and hermetically seals the valve.

Claim.—"We do not claim the precise size or form of the various parts, or the using of the precise materials herein described; but we claim exclusively the method of constructing and using valves as herein above described, for rendering available the application of direct tractive force, either on railways or otherwise."

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1. For a mode of *Graduating the velocity of moving bodies*; Edwin W. Jackson, Albany, New York, January 5.

This patent is obtained for a mode of regulating the velocity of moving bodies, which are subjected to the influence of an irregular or

accelerating force; such for example, as cars on an inclined plane, falling bodies, carriages drawn by restive horses, &c. &c. The apparatus employed consists of two concentric cylinders, connected together at their ends by flanches, with a space between them which is separated into equal compartments by partitions, provided with apertures, the capacity of which may be regulated by valves or shutters. Quicksilver, shot, sand, or water, is to be put into this space, in sufficient quantity to fill about one third of the compartments. To turn this double cylinder with a velocity greater than that with which the quicksilver, or other substance, runs through the apertures in the partitions, sufficient power must be applied to lift the whole contents; and it will be evident that by increasing or diminishing the capacity of the apertures, the facility with which it may be made to revolve will be regulated.

Claim.—"What I claim as my invention is, the mode of graduating the velocity of moving bodies by means of a changeable weight, such as quicksilver, water, sand, shot, &c., contained in receptacles of any given form arranged around or between two concentric cylinders or wheels, and communicating with each other by apertures in the partitions or divisions thereof, through which the changeable weight passes as described. I also claim the mode of regulating the velocity of the moving body by means of valves or shutters, which enlarge or diminish the size of the apertures through which the changeable weight passes."

We are very apprehensive that this extra amount of load will rarely be carried for the purpose of obtaining its regulating influence, and that there are but few situations in which it could be applied with any advantage.

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2. For an improvement in the *Horse Power for driving machinery;* Edmund Warren, city of New York, January 5.

The improvement claimed under this patent is in the mode of connecting the sweep or lever with the master wheel, or with its shaft, so as to prevent breakage by any sudden jar applied either to the sweep or to the machinery. A disk is attached to, and is made to turn with, the shaft of the master wheel, directly under the sweep; and this is provided with two bow springs on opposite sides of its upper surface; the sweep turns on the shaft, but is keyed down so near to the surface of the disk that it cannot turn without bending the bow-springs, which are so regulated, that when the sweep is pressed against them with the constant force necessary to carry the machinery, they do not yield, but when the horse makes a plunge, or the machinery is suddenly obstructed, they then yield, and the sweep passes around without any injury to the machinery.

The claim is to the "combination of the disk, or main wheel arranged as a disk, with the springs upon it, and the lever as a means of relief, or to prevent breakage of machinery."

3. For improvements in the apparatus for *Steering Boats;* Russell Evartz, Madison, New Haven county, Connecticut, January 5.

The steering chain in this apparatus, is made fast to a segment of a wheel at the rudder head, and passing thence, its ends are wound around, and made fast to two drums on a horizontal shaft, under the tiller house—the distance between the two drums must be equal to the diameter of the wheel at the rudder head; the chain, therefore, always acts upon the wheel in the line of its tangent, and the leverage on the rudder will be unvarying. The shaft of the tiller wheel, which has its bearings in a sliding frame, is provided with wheels of different diameters, either of which may be put in gear with a cog wheel on the shaft of the drums to which the steering chain is attached. Two chains are made fast to the rudder, and pass along under the gunwales to the bow, where they are attached to the windlass, by which arrangement the vessel may be steered in case of a fire, which would prevent the use of the tiller or rudder head.

Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in attaching a segment grooved wheel to the head of the rudder, around which the steering chains are passed, and to which they are made fast in such manner that the purchase shall always be at right angles to the diameter, in combination with the grooved drums on the horizontal shaft, around which the steering chains are wound, one on each side, and the gearing for turning said drums at a quicker or slower speed, by the arrangement of the cog wheels in the sliding frame, as described. Also, the arrangement of the life chains leading from the rudder to the windlass, along the gunwales, as before described."

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4. For improvements in the *Blast Furnace for smelting Iron Ores,* with bituminous or with anthracite coal; Stephen Chubbuck and Jedediah Briggs, Wareham, Plymouth county, Massachusetts, January 9.

The improvement in the blast furnace which is the subject of this patent, consists in keeping the melted iron, after it has run from the furnace into a basin provided for it, at the desired temperature by means of a fire on each side of said basin, and under the same arch which covers it. The fires on the sides of the basin communicate with a flue at the side of the smelting stack, which flue is provided with a damper at top, which, when closed, directs the draught through the stack.

Claim.—"What we claim as our invention, is the mode of keeping the metal in its liquid state to a proper degree of heat, by means of fires surrounding the basin containing said metal, and kindled and kept alive in an arch arranged in the manner described; and in combination with the foregoing arrangement, the flue governed by a damper, so operated as to permit the draught from the fires in the arch to ascend the flue, or when closed, forcing it into the smelting stack, as set forth."

5. For a machine for *Cutting Raw Hides or leather into strips* for making Ropes; Philip B. Holmes and William Pedrick, Charlestown, Middlesex county, Massachusetts, January 9.

The claim expresses the character of this invention so clearly, that we deem it unnecessary to add any explanatory remarks.

Claim.—"Having thus described our improvements, we shall claim as our invention, reducing or cutting hides, or other similar materials, into long bands or strips, by means of a revolving table, in combination with a circular or other proper shaped cutting knife, attached to a movable carriage over the same; said knife being caused to pass from the circumference towards the centre of said table, by the action of a revolving screw or similar apparatus, so as to describe a spiral or curved cut through the hide on said table, as the same revolves; the whole being arranged and operating together substantially in the manner as herein above described and set forth. We also claim the supporting of the periphery of the hide above the revolving table, while the circular knife operates thereon, by means of a platform attached to the knife frame through an elongated slot, in which platform the knife is inserted, and acts on the hide resting on the same, the whole being arranged and operating substantially as described."

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6. For an improvement in *Springs for Railroad Cars*, Locomotives, and other vehicles; William Duff, city of Baltimore, January 9.

The patentee says—"My invention consists in the particular manner in which I have combined and arranged the elastic spring made of steel plates, with any desired number of spiral springs, by which arrangement I obtain a high degree of elasticity, and graduate the action of the spring in accordance with the varying burthen which it is to sustain."

The plate springs are arranged and constructed in the usual way, and the spiral springs are placed either between the upper surface of the plate springs and the under surface of the side of the main truck, locomotive, or car, frame; or between the upper surface of the last mentioned side piece and the lower part of the frame of the body. The spiral springs are coiled around rods which pass through the first mentioned side piece, and rest on the upper surface of the plate springs.

Claim.—"What I claim, is the manner in which I have combined the steel plate springs, as constructed with scrolled ends, or with ends attached to vibrating bars, or to be received into pockets, with the spiral springs, which are so graduated in length as to be successively brought into action, according to the bearing of the load, as described."

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7. For a method of operating the working *Valves of Steam Engines;* John Wilder, city of New York, January 9.

An arrangement of levers for working the valves of steam engines, is to be made within the steam chest, and these are to be operated by the rod. The valve has a conical seat, and may work on a stem to insure its working truly. The main lever is jointed at one end to the

lifting rod, and at the other to the centre of the valve; and at its middle to a second lever which embraces it, and which has its fulcrum in a line with the joint, which unites the first lever and lifting rod, when the valve is closed.

The claim is to the "combination of the lifting rod, principal lever, and the second lever, with the eduction valve."

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8. For an *Hydraulic Wheel for Raising Water;* Pierre Désiré Henry, city of New Orleans, Louisiana, January 9.

This wheel is a modification of the well known hydraulic wheel for raising water, which receives the water in bent tubes at the periphery, and discharges it near the centre. It is to be made much narrower at the periphery, where the water is received, than near the shaft, where it is discharged. The space between its inner and outer peripheries is divided into compartments by partitions tangential to the inner periphery. These compartments are made to open at both ends; the openings at their outer ends, or at the outer periphery of the wheel, are provided with valves opening inwards, to admit the water when submerged, and to prevent its escape when leaving the reservoir, or lifting the water contained in the compartment. The water is to be discharged into a proper reservoir, or gutter. When the wheel is employed to raise water from a shallow place, a spoon or scoop is adapted to its outer periphery to catch the water.

The claim is to the "arrangement of the tubes or compartments for conducting the water to the gutter, in combination with the valves governing the inlets of the compartments; and also, in combination therewith, the spoons or scoops for sçooping the water up when the basin is low."

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9. For improvements in *Railroad Cars;* John A. Whitford, Saratoga Springs, New York, January 20.

The claims made under this patent refer throughout to the drawings.

The first improvement claimed is to an arrangement of parts by which the two trucks of a car are connected with each other, and with two windlasses, one at each end of the car, by means of which the axles of the wheels are to be thrown in the direction of the radii of the curve of the road. Each truck is provided with two racks that mash into two pinions, one on each side of the car frame; from the axis of each of these pinions extends an arm, to the outer end of which is affixed a chain that passes around the drum of a windlass at each end of the car. By turning either of the windlasses the axles are thrown out of their parallelism, and as the two trucks are connected by the racks with the two pinions, when one axle is shifted the other is shifted also.

The second improvement claimed is to the making of the axles in two parts, which are coupled together in the middle by means of a pipe, or ferule, in combination with a mode of adjusting them by

means of a pointed screw passing through a slide in each box, the head of which is cut into ratchets to prevent it from turning, a spring pall being applied thereto.

The third and last improvement claimed is in the combining two additional bow springs with the common spring. The two additional springs are arranged under the truck frames, one forward, and the other back of the pedestal, the ends bearing against the under side of the frame, and a bolt passing through the middle of each, and the side piece of the truck, and made fast to the ends of the main spring above, which bears on the boxes of the friction rollers that slide in the upper part of the pedestal—this car being so arranged as to have the bearings of the axles run on friction wheels.

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10. For a *Shingle Cutting Machine;* Truman Walcot, Stow, Middlesex county, Massachusetts, January 20; patent dated the 5th of September, 1840.

The improvement described in this machine consists in an arrangement of the parts of the carriage, by which the block is fed up to the knife at every upward movement of the knife gate. From the back of the carriage project two "toothed gauges," the teeth of which engage, alternately, with two *shippers*, which are connected with, or relieved from, the teeth of the gauge by two cams on the arbor of a ratchet wheel, which is turned by the gate at each upward movement. When the shippers are relieved from the cams they are drawn back against the teeth of the gauges by a spiral spring.

The claim is to the "combination of the ratchet wheel, cams, shippers, and toothed gauges."

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11. For an improvement in the *Seed Drill, or Corn Planter;* Calvin Olds, Marlborough, Windham county, Vermont, January 20.

This machine resembles a wheelbarrow, excepting that the shafts extend beyond the wheel to receive the necessary apparatus for forming the drill, &c. The circumference of the wheel is to be equal to the distance between the hills, it being provided with a projecting piece to mark the hills. On the axle of this wheel is another of less diameter, called the cup wheel, it being provided with a cup to receive the seeds from a shoe, or hopper, and discharge them into a spout, which drops them in a drill directly in front of the marking wheel. The cup wheel is movable on the axle of the dropping wheel, for the purpose of adjusting the two, to insure the marking of the place where the seeds have been dropped.

Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the cup wheel on the axle of the marking wheel, so as to render it adjustible, as described."

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12. For an improvement in the *Argand Lamp;* Benjamin Hemmenway, Roxbury, Norfolk county, Massachusetts, January 20.

The object of this improvement is to avoid the necessity of remov-

ing the oil chamber, in the fountain lamp, to replenish it with oil. The fountain or reservoir is supplied with oil through a short pipe at top, which is hermetically closed by a leather valve and screw cap; and between the bottom of this reservoir and the pipe that conducts the oil to the burner, is an air chamber, which is supplied with air by a tube passing up through the oil reservoir. From the bottom of the oil reservoir a tube, provided with a stop cock, descends to within a short distance of the bottom of the air chamber. When the oil chamber is to be replenished, the stop cock, in the tube at the bottom, must be closed, and the valve at the top may then be opened to receive the oil; and when the valve at the top is closed, then the stop cock may be opened. When this has been done, it is evident that the air from the air chamber will rise in the tube, at the bottom of the reservoir, and allow the oil to descend in the air chamber until it reaches the lower end of the said tube, and the oil reservoir being then hermetically closed by the valve at the top, the atmospheric pressure will prevent the farther descent of the oil. By this arrangement the inconvenience arising from the overflowing of the common fountain lamp is effectually guarded against, for by making the top of the burner a little higher than the lower end of the tube in the bottom of the oil reservoir, the oil can never rise above the given height.

Claim.—"I claim combining with the air chamber, in the manner set forth, a tube for admitting air to said chamber, and a stationary fountain or reservoir for containing oil, constructed as described; that is, having a tube to admit of a supply of oil when necessary, with a cap adapted to said tube, to exclude the pressure of the air, and a tube for conveying the oil to the air chamber, provided with a stop cock to intercept the communication while the fountain is being filled."

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13. For a *Safety Barge and Army Boat;* Solomon C. Batchelor, Cincinnati, Ohio, January 20.

For Specification, see vol. 1, page 114.

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14. For *Driving Machinery by the Foot;* Aaron Clarke, Greenwich, Fairfield county, Connecticut, January 20.

The machinery described by the patentee, is intended for driving silk reels, and for performing any light work, by means of a horizontal band wheel, and bands communicating with the machine to be driven.

The foot by which the wheel is to be turned, is to be passed into a shoe, which is connected to a crank pin on the face of a wheel, in such manner as to enable the operator to turn the wheel, which amounts simply to working a crank, or winch, by the foot, instead of by the hand.

It seems that there was novelty enough in the device, according to the judgment of the patent office, to justify the affixing its seal thereto; but we apprehend that the utility of the invention will not be sufficient in amount to render the purchasers of rights very numerous.

The claim is to the combination of the pin on the horizontal wheel, the oval block, and the shoe attached thereto.

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15. For an improved manner of constructing *Railroad Car Bodies;* George S. Hacker, Charleston, South Carolina, January 21.

This car body is to be cylindrical, and the patentee says:—"I am aware that carriage bodies for transportation of the mails, have been made cylindrical and hooped; but when thus constructed, the parts could not be tightly drawn by driving the hoops, and therefore I do not claim this as my invention. But what I do claim as my invention, and desire to secure by letters patent, is the construction of the body of a railroad car in the form of a barrel, hooped in the manner and for the purpose described."

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16. For an improved *Door Spring;* Samuel Sawyer, Boston, Massachusetts, January 21.

The object of this improvement is to increase the force with which the spring shall act on the door, as it closes, instead of decreasing it, as is the case with the springs generally employed. This is effected by increasing the leverage of the mechanism on which the spring acts.

At the upper part of the door is a pin which turns freely in a case, and around which is coiled a spring, attached by one of its ends to the pin, and by the other to the case. From the upper end of this pin projects an arm, at right angles, the outer end of which is jointed to a bar connected with the frame of the door by a joint at its other end. By this arrangement the tension of the spring acts on the pin, the arm of which, by its connexion with the bar above named, gradually increases its leverage as the door closes, and gradually decreases it as it opens.

The claim refers throughout to the drawings, and could not be understood without them; it is limited to the particular arrangement of parts above indicated.

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17. For a method of *Manufacturing Balls of Caoutchouc,* or India Rubber; Edwin M. Chaffee, Cambridgeport, Middlesex county, Massachusetts, January 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making of balls from caoutchouc, by chopping it fine or otherwise reducing it to small pieces, and separating and heating the same by throwing it into hot water, and afterwards pressing it in a mould constructed as above described."

The mould employed in this process consists of a hollow cylinder, the bottom of which is concave, and semi-spherical, and to said cylinder a piston is fitted, the lower end of which is also semi-spherical to correspond with the bottom of the cylinder. A hole is made in the bottom of the cylinder, and another through the piston, for the escape of

the water which is forced out in pressing. The proper quantity of the material being put into the mould, the ball will be readily formed.

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18. For improvements in *Corsets*; Elizabeth Adams, Boston, Massachusetts, January 21.

We make the following extracts from the specification.

"I do not intend my invention to be worn for the purpose for which the common corsets or stays are generally used, as it is larger both before and behind, and could not be worn in ordinary circumstances, without great inconvenience. It is to be applied to pregnant females, to support the protruded abdomen, and at the same time to allow of its increase in size, without any injurious increase of pressure, from time to time during the period of pregnancy. For this purpose I insert, in a proper manner, in the centre of the front of the corset, a wide steel spring or busk extending to the bottom of the same. The lower end of the spring or busk is curved, so as to readily to adapt itself to the distended part, and extends downwards a much greater distance than the busk of the common corset, or down to and beneath the very lowest part of the abdomen.

"On each side of the central busk is another spring or busk of less size. These latter springs are also slightly curved, in order to adapt them to the sides of the projecting abdomen. It will readily be perceived, from the peculiar shape of the several springs, that those parts of the body which are dilated during pregnancy, rest on and are supported by the same, and that any strain or weight falling upon the springs is conveyed to, and supported by, the shoulder straps.

"Steel springs, or strips of whalebone, are inserted in the body of the corset, and so secured as to support the projecting parts of the breast, and sides of the abdomen.

"Long slits, or openings, are made in the front of the corset, between the springs or busks; and these openings are secured together by lacings of common caoutchouc, or other suitable elastic cord or tape.

"I claim the combination, in a corset, of the front slits or openings, with the steel busk or spring, curved and shaped as described and represented in the drawings, so that while the said busk, in conjunction with the curved form, which it imparts to the bottom of the corset, serves to support the distended parts, the several slits in front allow the parts, as they enlarge, to expand outwards or horizontally; and the looseness of the corset above the abdomen, permits them to rise upwards when sitting or stooping."

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19. For a method of *Forming Ice*; Thomas B. Smith, St. Louis, Missouri, January 23.

The patentee says:—"My improved process for the rapid production of solid ice by the freezing of water, is dependent upon the well known fact, that a thin stratum of water when exposed to an atmosphere, the temperature of which is at, or below, thirty-two degrees of

Fahrenheit's scale, very rapidly becomes frozen. It is also a fact that after a thin sheet of ice has been formed upon the surface of water, the process of freezing proceeds but slowly, in consequence of the bad conducting property of ice for the matter of heat. Taking advantage of these laws, I proceed in the formation, or the making of ice, in the following way: I prepare a vat, or other suitable vessel, of wood, or other material, of any size that I may deem convenient, and this I place on a level, in such situation as shall best expose it to the freezing influence of the atmosphere. From any suitable reservoir I cause a portion of water to run into this vat, or other vessel, so as to cover the bottom thereof to the depth of an eighth, or fourth, of an inch, more or less, according to circumstances, and this water I allow to become completely frozen; when this has taken place, I in like manner supply another portion of water to be converted into ice. Proceeding in this way, I quickly obtain a thick stratum of ice, of perfect purity, if the water be pure, and of great solidity."

The vat, or reservoir, is described as being made with movable partitions, to form blocks of any desired size.

Claim.—"What I claim therein, and desire to secure by letters patent, is the manner herein described of rapidly forming thick sheets, or blocks, of ice, by the successive pouring of small portions of water into a vat, or other suitable vessel, allowing the same to freeze, and adding, in succession, fresh portions of water, as above set forth, until the process is completed."

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20. For a method of *Moving the Index on a Weighing Apparatus, or Scales;* Martin Robbins, Hollidaysburg, Huntingdon county, Pennsylvania, January 23.

These scales are a modification of that kind which indicates the increase of weight by elevating a weighted lever from a vertical to a horizontal line, the scale dish being suspended by a cord passing around a wheel on the axis of the lever. The drawings represent the figure of a man standing on a pedestal, between two columns, and the scale, or index, of pounds, &c., is marked on an arch based upon the columns. The two arms of the figure are the weighted levers, their axes being the shoulders, and having a wheel on each, to which is suspended the cords or chains that pass through the body and legs, and hold the dish, which hangs in the pedestal. A cord or chain passes from a wheel, on the axis of one of the arms, or weighted levers, to a wheel on the axis of the index, which axis is situated in the breast of the figure, and is the centre of the arch on which the index figures are engraved.

The claim refers to the drawings, but it is confined to the arrangement of the wheel on the axis of the index hand, in combination with the chain leading from it to the wheel on one of the weighted levers, "for causing the index hand to perform a semi-circle on the graduated arch for indicating the weight of the article to be weighed." This arrangement will make a very ornamental balance, but we are unable to perceive any feature of novelty in the apparatus which could au-

thorize the grant of a patent; the device may please the fancy, but in the general arrangement it does not differ from some other weighing machines, nor will it weigh accurately.

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21. For an improvement in the *Fire Escape;* Samuel Welsh and Thomas Linacree, city of Albany, New York, January 23.

In describing this machine the patentees say, "the machine or apparatus, which we have improved, is of that kind in which there is a box for containing persons, and such implements as they may need; which box, by the turning of a winch, may, by the power of those within it, be made to ascend, or slide up on a vertical shaft, to the height of twenty, thirty, or more feet. Said vertical shaft is, at its lower end, attached and braced to a piece of timber, which constitutes one of the axles of a carriage, upon which the apparatus is to be conveyed to and from a fire; the shaft, which is to stand vertically when in use, being then placed in a horizontal position."

The axle tree, of what are the hind wheels, when the shaft lies horizontally, is braced to the shaft on two sides by permanent braces; and to the other sides of the shaft are jointed two other braces, the lower ends of which are shod with iron, and are connected with the ends of the axle tree by adjusting bars. A pair of wheels are adapted to the other end of the shaft when it is moved from place to place. This apparatus is provided with a short ladder, with which to form a connexion or bridge between the box and a window; it has hooks also at each end and side, for greater safety to the persons ascending or descending. When the shaft is elevated the wheels are chocked by means of blocks that fit their peripheries.

Claim.—"Having thus fully described the nature of the apparatus which we employ to preserve the lives of persons, and to aid in removing property and extinguishing fires in buildings, it is to be understood that we do not claim to have invented this apparatus, so far as its general construction is concerned; but we do claim to have made certain improvements therein, by which it is rendered more convenient and efficient than it has been as heretofore constructed. We confine our claim to invention, therefore, to the particular manner of combining those parts thereof, by which it is held steadily when the shaft is being raised, and whilst it is in a vertical position; said combination consisting of the adjustable leveling bars, the movable braces, and the chock blocks, co-operating with each other in the manner set forth. We also claim the combining with such apparatus, the trough and ladder with the additional pulley for elevating and managing the same."

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22. For *Draughting and Cutting Ladies' Dresses, &c.;* Aaron A. Tentler, Philadelphia, Pennsylvania, January 23.

We shall not attempt to give a description, or the claims, in this instance, as they refer throughout to the several diagrams which are to serve as guides in the operation.

23. For a process of *Manufacturing Sulphate of Alumine;* Rudolph and Gustava Boninger, Baltimore, Maryland, Assignees of Max Joseph Funcke, of Eickelskamp, Prussia, January 23; granted for fourteen years from the 16th of November, 1839, the date of the English Patent.
(See Specification.)

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24. For an improvement in the *Corn Sheller;* John A. Whitford, Saratoga Springs, New York, January 23.

The kind of corn sheller to which the patentee refers, is that which shells the corn by means of a roller set with teeth, and working against a concave hung on springs, to yield to the different sized ears of corn. The improvement consists in the employment of a series of wheels, with teeth projecting from their peripheries, on a shaft which has its bearings in the concave. The teeth on these wheels work between the teeth of a comb attached to a plate projecting from the frame, the edge of which nearly touches the teeth of the main shelling roller. The shaft of the toothed wheels, or small sheller, has a pinion on its end, which mashes into a cog wheel, the shaft of which passes through the concave frame, and on which said concave frame vibrates, to enable the small sheller to vibrate with the concave whilst it receives its rotary motion from the cog wheel. The ears of corn are brought against the comb and plate, and there stripped of their grain, which passes out and descends an inclined board leading to a proper recepticle, whilst the cobs pass out at the side.

The claim is to the "arrangement of the lower or small sheller in the lower part of the concave, so that they shall yield together to different sized ears, as described, in combination with the upper or main sheller."

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25. For an improvement in the *Machine for making Bricks* from tempered clay; Thomas Conklin, Woodville, Wilkinson county, Mississippi, January 23.

The clay is to be mixed in a tub of the usual construction, the bottom of which is pierced with a long aperture, through which the mixed clay is forced into the moulds, as they are presented thereto, by a series of inclined arms, which are attached to the shaft of the mixing knives, immediately above the bottom of the tub. Below this bottom, the shaft of the mixing knives has a circular platform attached to, and revolving with it to receive and carry round the moulds, which are hooked on to an endless chain that passes around a drum on the above mentioned shaft, and around another at the outer end of the way on which the moulds slide. After the moulds have passed under the aperture through which they are filled, they are conducted under two weighted pressers that press the clay into them, and then under a wire striker that cuts off the surplus material. The way or platform on which the moulds slide, is provided with an inclined plane at the outer end, which lifts the moulds, and thus unhooks them from the chain.

The circular revolving platform that carries the moulds round under the tub, is pierced with large holes to allow the clay which drops from the tub and from the moulds, to fall through out of the way of the machine.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the before described arrangement of the endless chains to which the moulds are attached, and the way, guides, and inclined planes, in combination with the circular revolving platform; the mixing tub, inclined dischargers therein, pressers, striker and discharger for making bricks in the manner herein set forth—there being a continuous line of empty moulds made to pass under the discharging aperture in the bottom of the mixing tub, whilst at the same time a similar line of filled moulds are made to leave the aforesaid aperture, pressed, struck, scraped, and the moulds liberated from the chains by the inclined plane at the end of the way, and in combination therewith, the endless chain for supplying the clay as described."

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26. For a machine for *Heading Spikes;* Robert S. Harris, Wilmington, Delaware, January 25.

The proposed improvement is on the common jaws, employed to hold the spikes in heading them with a hand hammer. The jointed jaw is opened and closed by a toggle, which is connected above by a link with a spring to open the jaws, and with a treadle below to close them. In the hole of the griping dies there is a pin on which the point of the spikes rest to prevent them from driving through; this slides in a hole made in a rest which prevents it from descending too low, but permits it to slide up. The lower end of this pin is connected by a lever with the treadle, so that as the jaw is opened by the action of the spring, the treadle is drawn up, which, by its connexion, forces up the pin, and thus liberates the spike from the dies.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the jaw, toggle joint, and spring, for the purpose of throwing open the jaws as described, and these parts, thus combined, I claim also in combination with the treadle, rest or support, and the pin, with their connexions, for the purpose and in the manner specified."

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27. For an improvement in *Dampers or Valves in Chimney flues;* Normand Smith, Hartford, Connecticut, January 25.

We deem it sufficient in this instance to give the claim on which this patent rests, which is in the following words, viz:—"I am aware that chimneys have been supplied with valves or shutters in the throat or flue, for the purpose of regulating the opening in the throat, or entirely closing it, and therefore, I do not claim this as of my invention; but what I do claim as my invention, and desire to secure by letters patent, is the peculiar manner in which I have applied the dampers or valves, so that they can be removed at pleasure without removing any of the fixtures, to which, or by which, they are attached, by having

the pivots of the valves drop into notches, made in the iron framing, which is attached, or let into, the throat or flue of the chimney, in which they are retained by the weight of the iron valves, but from which they can be removed for the purpose, and in the manner, specified."

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28. For *Working the Valves of Steam Engines;* Robert L. and Francis B. Stevens, New York city, January 25.

The improvement which is the subject of this patent, is in the manner of working the valves of steam engines, in which the steam is to be cut off and used expansively. The following is extracted from the specification.

"Engines in which the steam is cut off, have either a separate valve or else use the steam valves themselves for that purpose; when the steam valves are thus applied, the mode hitherto used for working them has been by means of a cam wheel placed on the main shaft of the engine, which, through the intervention of a rod and rock shaft, raises and lowers the valves at proper intervals, or by means of tapets placed on the lifting rods, or on the pump rods, which last method is commonly known and described as the hand gear."

"In our improvement, (the exhaust valves being worked by any of the several methods hitherto used for that purpose,) we raise the steam valves and lower them at any portion of the stroke of the piston, by means of a separate and independent crank or eccentric wheel, giving an alternate rotary motion to a rock shaft, which by means of two toes, placed on the opposite sides of its centre of motion, alternately raises and depresses each valve. When the toes are affixed to the rock shaft so that their faces are in the same straight line, as soon as the toe on one side of the rock shaft has lowered one valve, the toe on the opposite side of the shaft begins to lift the opposite valve; in this case one valve is not closed until the other begins to open, and the steam is not intercepted until the end of the stroke of the piston; but when the toes are fixed to the opposite sides of the shaft so that their faces are not in the same straight line, but are depressed to an angle less than two right angles, after the toe on one side of the rock shaft has lowered the valve, the rock shaft will revolve through a certain interval before the toe on the other side of the shaft begins to lift the opposite valve: during which interval neither valve being raised, the steam in the cylinder will be acting expansively."

"What we claim as our invention, is the combination of an additional and separate eccentric wheel to work a rock shaft to raise the steam valves, in combination with any of the several methods hitherto used for working the exhaust valves. We also claim the manner in which the toes are affixed to the rock shaft, so that the shaft is made to vibrate during a certain interval, without either toe communicating motion to either valve. We also claim the combination of the cog wheel and rack, in the manner set forth, for the more completely effecting our object."

The last improvement claimed, is for affixing a rack on the end of the eccentric rod, to work in a cog wheel on the end of the rock shaft,

as a substitute for the eccentric hook and arm, when it is desired to give a greater amount of motion to the rock shaft.

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29. For improvements in the *Barometer;* William R. Hopkins, Geneva, Ontario county, New York, January 27.

In this improved instrument, the range, or rise and fall, of the mercury in the tube is to be ascertained by weighing, instead of being indicated by the scale usually employed. The bulb end of the tube is provided with a sack communicating with the tube, which communication may be closed when desired, by a valve and screw. When it is desired to weigh the mercury, the valve leading into the sack is closed, the instrument placed horizontally on a knife edge attached to the tube, and a scale dish suspended from the end of the tube opposite the sack.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of ascertaining the weight of the mercury in the barometer tube, by weighing the quantity remaining in the reservoir or cistern of the barometer. I also claim the sack and valve in combination with the barometer tube, by means of which the flow of mercury can at any time be arrested for the purpose of weighing."

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30. For an improvement in the *Corn Sheller;* Charles Willis, Chel sea, Suffolk county, Massachusetts, January 27.

This corn sheller is one of that kind which have a shelling wheel or disk furnished with teeth on both faces, and having two holding spouts; the improvement consists in having two plates, one on each side, which form the bottom, or rather, back of the holding spouts, and against which the ears of corn are borne during the operation of the shelling wheel. These plates are movable and adjustable by means of screws, so as to regulate the distance between their inner edges and the faces of the shelling disk.

The claim is to the "movable plates placed in the rear of the holding spouts, and capable of being adjusted by screws to such distances from the teeth of the rotary circular plate, as may be desirable, as described."

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31. For an improvement in the manner of forming *Blocks of Wood for Paving Streets;* James H. Patterson, city of New York, January 27.

The patentee says—"I cut my blocks rectangularly, or nearly so, in all their parts, and adapt them to each other in such a manner as that they shall interlock, and that no single block in the series which crosses a road, or street, can be pressed down without depressing the whole series; thus distributing the weight which bears upon them in one part, over the whole number. Under the arrangement here indicated, the blocks interlock on those sides only which are in contact with each other in crossing the road or street."

"What I claim as constituting my invention, and desire to secure by

letters patent, is the cutting of such blocks on two of their sides, so that they shall have four, or more, rectangular offsets, as herein described, when said blocks are intended to support each other in a straight line only, crossing the road, or street; and as it will be manifest that the principle upon which I shape my blocks may be carried out by forming a greater number of rectangular faces and off-sets, I do not intend to limit myself in this particular; but I am confidently of opinion that any change in these particulars would only render the plan of contruction more complex, without being productive of any advantage."

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32. For an improvement in the *Domestic Spinner* for Spinning Wool; John Nelson, Jefferson, Logan county, Ohio, January 27.

This patent is obtained for an improvement in the arrangement of the parts of the well known family spinner for spinning wool, and which works on the principle of the old spinning jenney. The drawing carriage has the usual rollers, apron, and clamp for measuring out the length of roving at each operation. One of the rollers has a pinion on one end, which turns freely on its axis, in one direction, and in the other carries the roller around with it by a ratchet wheel and pall. As the carriage advances towards the spindles in winding on, the ends of the spring clamp are thrown open by two wedge pieces on the frame, and then kept open by a catch; during this, the pinion on the end of the roller is passing under a rack, attached to the frame, and turning freely on its axis, but when it changes its motion and runs back, then the roller is turned by the rack and pinion which gives out the roving, the length of which is regulated by the adjustment of a trigger which disengages the catch on the clamp, and thus arrests the farther supply of roving.

Claim.—"What I claim, is the manner in which I have constructed the clamp and its appendages, making a part of the carriage, and arranged the respective parts thereof, as described, so as to be operated upon by the rack, the wedge pieces, and the trigger, in the manner, and for the purpose, set forth. I do not claim the manner of constructing the clamp, the pinion or ratchet wheel, or either of the parts taken alone, but only in their combination with each other, in the manner set forth."

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33. For an improvement in the *Curriers' Beam;* Ichabod Lindsey, Charlestown, Middlesex county, Massachusetts, January 27.

The wooden beam usually employed by morocco dressers and curriers, is rendered uneven by the action of the tanning liquor, and of the knife; and to obviate these difficulties, the patentee has substituted a slab of marble, metal, or other hard substance, for the wood heretofore employed.

The claim is to the "method of constructing curriers' beams by inserting a slab of marble, or other hard substance, in the wood, by which means the utility of the instrument is greatly improved."

34. For a *Fire Alarm;* Theophilus Goodwin, of Exeter, New Hampshire, assigned to Josiah Brown, Brentwood, New Hampshire, January 30; antidated July 30, 1840.

The above named invention is for giving an alarm in case of fire in a house, by the expansion of a bar of metal, which is to start the trigger of an alarm bell.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of the expansion of metals by heat to start an alarm in case of fire, in the manner and for the purpose described, using any of the solid metals, and applying them in any shape to produce the same effect."

A patent was granted to Rufus Porter on the 28th day of December, 1840, for an apparatus similar to this, but upon a hearing of testimony before the Commissioner of patents, the priority of invention was decided in favour of Mr. Goodwin, and the above named patent was therefore granted to him.

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35. For an improvement in the *Ink Stand;* Isaac M. Moss, of Philadelphia, Pennsylvania, assignee of John Farley, Washington, District of Columbia, January 30.

(See Specification.)

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36. For an improvement in the manner of *Discharging Fire Arms;* Joshua Shaw, January 30.

(See Specification vol. 1, p. 117.)

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37. For an improvement in the *Brick Press;* Thos. W. Smith, Alexandria, District of Columbia, January 30.

The brick to be pressed is placed upon a horizontal sliding table, which sustains a system of progressive levers of the kind usually denominated the toggle joint, by which the pressing is to be effected. The sliding table is carried forward by a rack and pinion beneath it, and the whole apparatus is arranged in such a manner as to render it both efficient and convenient. Although not complex, it would not be easy to describe its construction intelligibly without the drawings, and we will, therefore, only give the claim, which is to "the forming of the pressing mould by means of the frame, the sliding table, and the standard and follower thereon, constructed and operating as set forth. Likewise, in combination with such a machine, the distinct and independent manner of pressing the brick, and of carrying the brick forward into the pressing mould, and removing it therefrom, the whole being constructed and operating substantially as described."

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38. For an improvement in the *Gridiron* for broiling meat; Isaac Damon, Northampton, Hampshire county, Massachusetts, January 30.

This gridiron is of the usual square form, and instead of the bars

and open spaces, it is made of a crimped, or corrugated metal plate, without openings. At the back there is the usual dripping pan, and a fender is placed immediately in front of it to protect the gravy from the action of the fire.

Claim.—"What I claim as my invention and improvement upon the common gridiron, and desire to secure by letters patent, is the employment of the crimped metallic plate, instead of bars or open spaces, and also, of the fender between the dripping pan and the fire, as described."

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39. For an improvement in the *Machine for Stretching Horse Collars;* James P. Osborn, Reddington, Hunterdon county, New Jersey, January 30.

This machine consists of a metal stock, on which the collar to be stretched is put; the stock is made in two parts, which are hinged together at the larger end; and within this is placed a wooden *form*, which slides upon the bench, by the aid of a screw rod and crank. A rope is passed around the collar after it is placed on the metal stock, and is made fast to a nut that travels on another screw rod, provided with a crank. By turning the two screw rods, the two sides of the stock are forced out by the sliding of the wooden *form* within it, whilst at the same time, every part of the collar is made to hug, and take the form of, the stock by drawing of the rope.

The claim is to the "combination of the metal stock, the movable wooden form, the manner of using the rope, and the cranks and screw rods."

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40. For improvements in the *Carding Machine;* Ebenezer and Alanson Crane, Lowell, Middlesex county, Massachusetts, January 30.

The top cards instead of being permanently attached to the frame, are affixed to a traveling endless belt, passing around a roller at each end, and one at top in the middle—they are prevented from approaching too near to the main card by a segment plate, over which the ends of the pieces, forming the chain, travel. As the top cards approach the top roller, they are stripped by a stripping card attached to the ends of two "sweeps," or arms, that receive a reciprocating motion from a crank. After stripping the top cards, it passes over a small permanent card which cleans it.

The rollers and segment are provided with adjusting screws.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the attaching or fastening the top cards of the carding machine to revolving endless chains or belts, instead of securing them to the frame of the machine, and making them stationary as heretofore practiced, as described: and the application of such belts in combination with the rollers and adjusting screws and segment of a circle, to the purpose of conveying the top cards of the carding machine to, and placing them in, a position where they can be stripped by power, and the combination of the sweeps and stripping and clean-

ing cards, and crank for the purpose of stripping the top cards by power, when placed in such position as described."

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41. For an improvement in the *Endless Chain Horse Power;* Jeremiah M. Reed, Middlefield, Otsego county, New York, January 30.

The endless floor of this machine is formed by the union of a sufficient number of four wheeled cars, the wheels of which travel round in the space formed by two endless railways on each side, the space being a little wider than the diameter of the whole. The cars are connected together by links jointed to their bottoms. Motion is communicated to a shaft by racks attached to the bottom of the cars.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the endless chain upon which the horse, &c., walks by uniting together in the manner described a sufficient number of four wheeled cars, as described, and also running the wheels in the space between the two endless rails on each side, in the manner described."

Specifications of American Patents.

Specification of a Patent granted to James C. Booth, *of Philadelphia, Pennsylvania, December 5th,* 1840, *for a mode of Whitening or preparing what is termed "Fair Leather."*

Be it known that I, James C. Booth, of Philadelphia, Pennsylvania, have invented a new and improved mode of manufacturing, preparing, whitening, or making, what is termed "Fair Leather," and I do hereby declare that the following is a full and accurate description.

In order to obtain or put the leather in the state designated, so that it may have the peculiar light-colored and fair appearance which is the object of the invention, I employ it (the leather) in that stage of the manufacture when it is in its moist state, after it is "finished;" or if it is used when the leather is dry, then in the latter case it must be moistened through with clear water. While it is thus wet, I spread with a sponge, brush, or other suitable article, the following liquid composition over the fair surface of the leather, giving it sufficient dampness to let the pores absorb the liquid. The liquid to be applied, is a solution of the protomuriate of tin in muriatic acid, ether, alcohol, and water, and is composed as follows:—Any quantity of the protomuriate of tin is dissolved in about one half of the weight of muriatic acid, and to this solution ether is added in the proportion, by weight, of three times the weight of the protomuriate of tin, and then a quantity of alcohol by weight, equal to four times the weight of the protomuriate of tin. To this may be superadded clear fresh water in the proportion of three parts by weight, as compared with the protomuriate of tin.

If the leather to be employed under this process is not clear, or is very dark, or spotted, then a greater proportion of muriatic acid is to be used, say an equal quantity, by weight, or twice as much, by

weight, as compared with the protomuriate of tin. Immediately after the application of the above described liquid composition to the leather, I spread over it, in a similar manner, spirits of turpentine with or without a small quantity of tallow, dissolved in it, sufficient to make it pliable, and the leather is suffered to dry in the ordinary manner, and the operation is complete. The spirits of turpentine, alone will generally be sufficient to give pliability to the leather after the first composition is employed, without adding the tallow, but when the leather is stiff or hard, or not sufficiently soft, the tallow may then be added. The leather after this process will have the required whiteness and fair appearance.

What I claim as my invention or discovery, is the use of the protomuriate of tin dissolved in the manner, and by the liquid, above described, for the purpose of communicating a light-colored and fair appearance to leather, whether the leather be oak tanned, bark tanned, hemlock tanned, with its natural or ordinary color.

JAMES C. BOOTH.

Specification of a Patent for a Process of Manufacturing Sulphate of Alumine. Granted to RUDOLPH AND GUSTAVA BONINGER, *of Baltimore, Maryland, Assignees of* MAX JOSEPH FUNCKE, *of Eichelskamp, Prussia, 23rd of January,* 1841*; patent to run fourteen years from the* 16*th of November,* 1839*—the date of the English patent.*

To all whom it may concern: Be it known that I, Max Joseph Funcke, a subject of the King of Prussia, residing at Eichelskamp, in the circuit of the government of Dusseldorf, in the said kingdom, have invented an improvement in the manner, or process, of manufacturing sulphate of alumine, so as to produce the same free, or very nearly free, from iron, and from alkali; whereby it is more perfectly adapted to be used as a mordant, or for other purposes, in the useful arts, than the alum of commerce, or than the sulphate of alumine, as ordinarily prepared. And I do hereby declare that the following is a full and exact description thereof.

I take potters' clay, pipe clay, or clay of any other kind, as free from iron as it can possibly be obtained; and this I dry at such degree of heat as is necessary to drive off all its free moisture. The clay so calcined, is next to be reduced to powder, and this powder I put into suitable leaden vessels, or vessels of other material not acted upon by sulphuric acid; to these vessels a moderate degree of heat is to be applied, by means of steam or otherwise. Sulphuric acid, of 66° Beaumé, is then to be added to the clay, in such quantity as shall suffice to dissolve nearly the whole of the alumine contained in the clay; which may be ascertained by a previous test on a small quantity. An excess of acid should not be used, as the whole ought to be perfectly neutralized by the alumine.

After the addition of the acid, the mass in the pans is to be stirred until it is perfectly dry; boiling water is then to be added in sufficient

quantity to dissolve the whole of the salt. The liquid thus obtained is to be placed in vats, and to remain at rest until it becomes perfectly clear. It should then be tested by means of lime water, to be certain that it does not contain any free acid; and should any be present, lime water is to be added until the whole excess of acid has combined with the lime, and has been precipitated in the form of sulphate of lime. When perfectly clear, the liquid is to be drawn off into other vats, preparatory to the separating from it the iron, which will always be found contained with it in greater or a less quantity. A measured portion of this liquid, say one pint, is then to be taken, and the iron contained in it is to be precipitated, by means of a solution of prussiate of potash, in such manner as to ascertain the exact quantity of said solution necessary to the precipitation of the contained iron. The quantity of liquid contained in the vat being known, the portion of the solution of the prussiate of potash necessary to the precipitation of the whole of the iron will consequently be known, and this is to be added to it, the mixture stirred, and the prussiate of iron formed, allowed to go to the bottom. The liquid is then to be drawn off clear from the precipitate, and a pure, or nearly pure, solution of sulphate, of alumine will be thus obtained; and it may in this state, be applied to various purposes in the arts.

If desired, the water may be quickly evaporated in leaden or other vessels, until a pellicle appears on its surface; when it may be put into suitable forms, and allowed to cool and crystalize, or consolidate.

I am aware that clay has been heretofore treated with sulphuric acid, to form a sulphate of alumine; and I am also aware that it is known to every chemist that iron may be precipitated from its solutions in sulphuric, or other acid, by means of prussiate of potash. I do not, therefore, make any claim to the discovery of either of these processes when taken alone; but I do claim the combination of means herein pointed out for the manufacturing of sulphate of alumine, by which it is produced with greater facility, and in a state of greater purity, than by any of the processes heretofore adopted in its manufacture; that is to say, I claim, in combination, the preparing of the clay by dessication, the combining thereof with sulphuric acid, and the subsequent solution and precipitation of the iron, substantially in the manner, and for the purpose, herein fully made known.

I will here observe, that although I have pointed out a solution of the prussiate of potash as the article by which the iron is to be precipitated, I have done so because I esteem this as the best mode of obtaining the end desired; but I do not intend hereby to limit, or confine, myself to the use of this salt, but to use any other of the known reagents by which a similar result may be attained, and a sulphate of alumine free, or nearly free, from alkali, may be produced.

MAX JOSEPH FUNCKE.

Specification of a Patent for an improvement in Ink Stands. Granted to ISAAC M. MOSS, *of Philadelphia, Assignee of John Farley, Washington, District of Columbia, on the 30th of January,* 1841.

To all whom it may concern: Be it known that I, John Farley, of Washington, District of Columbia, having invented a new and improved mode of using ordinary writing ink, and hereby declare the following to be a full and exact description.

The nature of my invention is such as to accomplish all the desiderata in writing: such as facility in the use of the ink, purity in the fluid, preservation from moulding, &c., by the employment of capillary attraction in the following manner, viz:—I provide the stand with an air tight stopper, which screws into the top and centre of the stand. In the centre of this stopper is a small funnel, or reservoir, communicating by an aperture with the interior. Through this aperture I insert a wick, possessing the capillary property of the sponge. The stopper being screwed down, causes the ink to rise in the reservoir for use, in a pure and limpid state, and by reversing the motion, the ink falls at pleasure, and is secured from deterioration or accident. The capillary action being an independent effect, per se, will result with or without the intervention of a tube.

What I claim as my invention, and desire to secure by letters patent, is the employment of a capillary action for the purpose of supplying the ink, as herein described, in combination with the air tight stopper, arranged and operating as above set forth.

JOHN FARLEY.

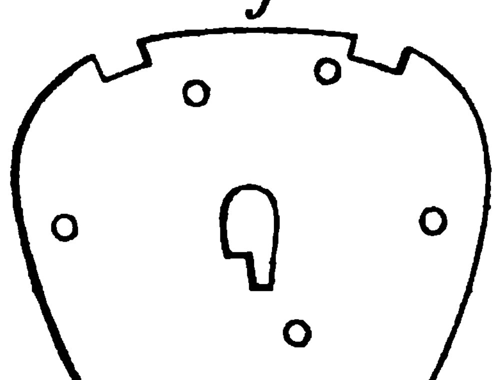
Specification of a Patent for an improved Padlock, called the Clam Shell Padlock. Granted to SOLOMON ANDREWS, *Perth Amboy, New Jersey, December 5th,* 1840.

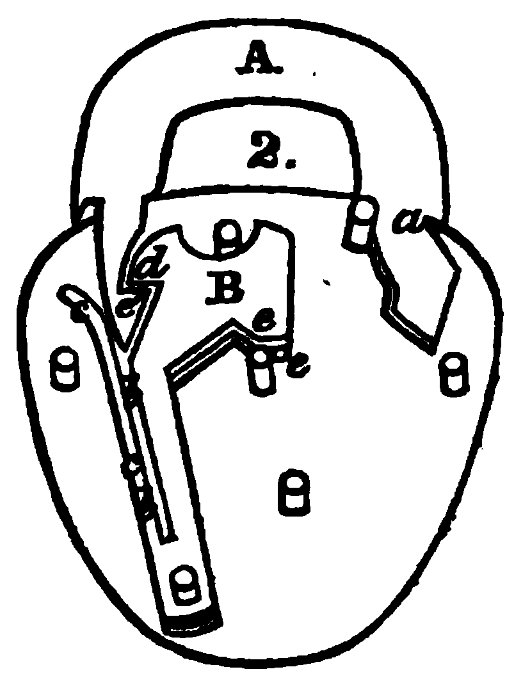
To all whom it may concern: Be it known that I, Solomon Andrews, of Perth Amboy, in the county of Middlesex, and state of New Jersey, have invented an improvement in the manner of constructing padlocks, which improved locks I denominate the clam shell padlock, and which is particularly applicable to mail, and other traveling, bags, although it may also be used for other purposes; and I do hereby declare that the following is a full and exact description thereof.

The distinguishing features of the lock, are the manner in which I construct, or form, the shell, or case, within which the key operates upon what I call the spring hooks; the manner in which I form these spring hooks, and also the way in which I connect the bow, or hasp, with the shell, or case, without the employment of a joint pin. The shell, or case, consists of two plates, or pieces of metal, only, which are struck up in the same die, and are, therefore, exactly alike in form. Fig. 1 represents one of these plates, which when laid upon, and riveted to, a corresponding plate, forms the shell, the edges of which are curved, or rounded.

Fig. 2 shows the interior of the lock, the key-hole plate, fig.1, being removed. A is the bow, or hasp, which is embraced at its joint part by the sides of the shell, and is thereby held in place, the part which enters the notch at *a* serving as the fulcrum upon which it turns; it is thus left solid, not requiring to be perforated for a joint pin. B is one of the spring hooks; of these I generally employ from four to six, placed one above the other; but any desired number may be used. I usually cut each of these spring hooks out of a single plate, with a slit, *b*, *b*, along it, so as to constitute the part *c*, *c*, a spring which admits the catch of the hasp to come under the hook when the hasp is shut, or pushed in, and hold it there until it is released by the key; and when the key forces the hook, or catch part, *d*, back, it will cause the upper end of the spring to bear against the inclined portion, *é*, of the catch of the hasp, and will cause the hasp to fly out, as soon as it is relieved from the action of the catch part of the spring hooks. The side of the key bits, (which may be of different lengths,) when turned open the lock, bears against the lips, *e*, *e*, of the spring hooks, to each of which they are adapted and fitted in a way well understood by locksmiths. When the key is not acting upon the spring hooks, or the hasp is not being pushed in so as to be held by the catch, there is no tension whatever on the spring, *c*, *c*, but it is quite free, exerting no pressure at all on the catch.

Fig.1.





Having thus fully described the construction and operation of my improved mail bag padlock, what I claim therein as constituting my invention, is: first, the forming of the shell, or case, of two pieces of plate metal, raised, and adapted to each other, in the manner set forth. I do not claim the raising of metals by means of dies, this being a well-known process, but I limit my claim to the manner in which I have adapted the raised plates to the forming of the shell of a padlock, instead of making it by casting, or by joining a rim on to wrought metal; as by this adaptation I have not only improved the form, but have given additional strength, and that at a diminished cost. Secondly, I claim the manner of combining the bow, or hasp, with the shell of the lock, without the use of a joint pin, as herein fully set forth. Thirdly, I claim the manner of forming and using the spring hooks, as described; the springs being so arranged as to be

brought into action by the shutting of the hasp, and by the turning of the key, and causing the hasp to fly out, by the pressure of the springs against the inclined point of the catch.

It will be manifest that variations may be made in the manner of forming and arranging the respective parts of the lock herein described, and I do not, therefore, intend to limit myself in this respect; the springs may be made separate, and attached to the spring hooks; and other changes of a similar kind may be introduced in other parts, whilst the instrument will remain substantially the same, producing a like result by analogous means.

SOLOMON ANDREWS.

English Patents.

Specification of a Patent granted to JOHN WILLIAM NEALE, *of Kennington, and* JACQUES EDOUARD DUYCK, *of Old Kent Road, for certain improvements in the Manufacture of Vinegar, and in the apparatus employed therein, September 8th,* 1841.

These improvements consist in the manufacture of vinegar from beet-roots; these roots, after being thoroughly washed, are reduced to the state of pulp by rasping. A number of strong cloth bags are filled with this pulp and placed in a press with a board or hurdle between them, and subjected to a powerful pressure, till the whole of the saccharine juice is extracted. The juice, which will vary in strength from about 7° to 9° of the areometer, is to be reduced to 5° by the addition of water, and boiled; the liquid is then removed to the coolers. On the temperature falling to 60° Fahr., the wort is removed to the fermenting vat, and half a gallon of yeast added for every 100 gallons of wort.

When the fermentation is over, the liquor is removed to the acidifying vessel, which is a strong vat capable of holding 24,000 gallons; in its centre, at a short distance above the bottom, there is a perforated rose, communicating by a pipe with a blowing machine. A steam worm lies at the bottom of the vat, communicating with a boiler, and furnished with a stop-cock, the other end of the worm being open to the atmosphere. The vat is divided into several compartments by perforated diaphragms, and in the cover of the vat there is a valve opening upwards.

Two thousand gallons of vinegar are first let into the vat to serve as mother to an equal quantity of fermented wash, which is next introduced, with a little yeast, when acetous fermentation quickly ensues. Air is then forced in through the perforated rose, which in its passage through the perforated diaphragms enters into intimate contact with the liquor, imparting a portion of oxygen to it, and expelling the carbonic acid gas through the valve in the vat cover. When the temperature of the liquor falls below 70° Fahr., steam is admitted to the worm, so as to maintain the temperature constantly between 70° and 80.°

In a few days the liquid will be converted into vinegar, when 4000 gallons more of fermented wash are let into the vat, and the process continued until the whole 8,000 gallons become vinegar. This course is pursued until the vat contains 24,000 gallons of vinegar, when 8000 gallons are drawn off and clarified, and replaced with 8000 gallons of fresh wash, and so on continuously.

The claim is—1. To the improved process and apparatus for manufacturing vinegar from beet-roots.

2. The process and apparatus for effecting and maintaining the acetous fermentation, and all such modifications of the same, wherein the acetous fermentation is conducted by the combined operations of an air-forcing apparatus and steam-heat applied in pipes or vessels within the acidifying vessel, whether the process of conducting the acetous fermentation be applied to the making of vinegar from beet-roots, or any other substances.

3. To the application of an air forcing apparatus in the manufacture of vinegar, or acetous acid, distinctly considered from the other parts of the apparatus. Lond. Mechanics' Mag.

Specification of a Patent granted to WILLIAM SAMUEL HENSON, *London, for certain improvements in Steam Engines, August 16th,* 1841.

In this high pressure condensing steam-engine, the steam chambers are each furnished with an escape-valve closed by a spring; these valves are kept shut by rods and levers worked by cams on the main shaft, the pressure of which is withdrawn when the valves are to be permitted to open. Thus, supposing the piston to be near the completion of its downward stroke, the pressure is removed from the upper escape-valve, when the steam forces it open, and rushes out until the steam within the cylinder is reduced to a slight excess above atmospheric pressure, when the spring closes the valve; the upper eduction-valve is now opened, and the remainder of the steam passes into the condenser. The piston then makes its upward stroke, and the opposite set of valves act in a similar manner.

The engine is furnished with two condensers, each having a valve at the top opened by rods worked by the engine; and also a valve at bottom kept shut by a spring, but opening into a casing, which communicates by a valve opening outwards with a cold water tank. Each condenser is provided with a jet, and is inclosed in a separate cistern, having a side valve for the admission of cold water, and two valves in its base through which the water is conveyed into the casing, and thence back into the cold water tank. At the termination of a stroke, the steam is admitted through the eduction-pipe into a chamber above the condensers; the upper valve of one of the condensers being opened, the steam enters and forces out the condensation water of the previous stroke through the lower valve, escaping with it, until the steam in the chamber is in equilibrium with the atmosphere, when the spring closes the lower valve.

The upper valve of the other condenser is now opened, and the remainder of the steam admitted and condensed by the injection of cold water, producing a partial vacuum within the condenser. During these operations, the cistern of the latter condenser is filled with water, while the former is empty. Towards the termination of the succeeding stroke, the water is allowed to run off from the latter cistern, by opening its lower valve, and the jet is turned off: at the same time cold water is admitted into the cistern of the first condenser and its jet turned on. The same operations as before then take place, the order of the condensers only being reversed.

In order to guard against explosion, the patentee places a governor on the top of the steam boiler, which is connected with the safety-valve by a long lever, in such a manner, that while the engine is at work, and the governor in motion, the safety-valve is closed, but as soon as the engine stops, the governor opens the safety-valve and lets off the steam.

The claim is—1. To the application to the cylinder of a steam-engine using a condenser, or to the passages between the cylinder of a steam-engine and its condenser, of an apparatus of the nature of that described, so as to permit the escape from the cylinder, or from the steam passages between the cylinder and the condenser, during a very short interval of time near the termination of each stroke, of so much steam as will leave the remainder of the steam within the cylinder but little above atmospheric pressure, and condensing that remainder by the means ordinarily used in condensing engines.

2. To the clearing the condensers of steam-engines, in which high pressure steam is used, by the application to that purpose of part of the force by which steam, used in such engines, exceeds the pressure of the atmosphere, when combined with condensers, at intervals immersed in water, as described.

3. To the application of a governor to the safety-valve of steam-engine boilers, by which the safety-valve is raised when the engine is at rest.

Ibid.

Specification of a Patent granted to John Godwin, *of Hackney Road, for an improved construction of Piano Fortes of certain descriptions. August* 23, 1841.

The improvements here patented relate to the construction and arrangement of the different parts of horizontal pianos, the strings of which pass from the plate over the bridge on the sound-board in the usual manner, and under a bridge beneath the wrest-pin block. The strings are each passed round a separate pulley, and are then carried up in front of the block to the wrest-pins, and are secured in the usual way. These pulleys are made in sets, according as the instrument is to have two or three unisons, and the mounting of each set has a shank attached to the lower angle of the front of the wrest-pin block, which is cut away for that purpose. The wrest-pin block is of a rectangular form, (eight inches wide, and four inches deep,) and

is composed of two pieces; the lowest of which is cut away to admit a strap on one end of a bar, the other end of which is attached to the string plate. There are several of these straps, which are let in to counteract the tendency of the tension of the strings to depress the front and elevate the back of the wrest-pin block. For this purpose, an iron bolt, three-sixteenths of an inch in diameter, is also passed through each bar, through the sound-board and bracket, and secured above the bar by a nut, and beneath the bracket by a washer.

The sound-board is placed three inches and a half below the strings, and is extended two inches farther than usual towards the front of the instrument, under the vibrating part of the strings. This extènsion may be carried through the whole length of the scale, but it is preferred to go only as far as where the treble notes do not require dampers.

In order to effect the action of the key upon the hammer and damper, under this arrangement, the damper level is placed between the sound-board and the strings, and the bracket is made quite straight. The key is shortened about two inches, and a right angled piece of metal, fixed on the end of it, communicates the action of the key to the damper lever. The check is carried farther back on the key, and a cheek piece is attached to the middle of the shank. The hammer rest is also removed higher up, and the length between the head and the shank of the hammer is reduced to an inch. Ibid.

Specification of a Patent granted to William Edward Newton, *of Chancery Lane, for improvements in obtaining a concentrated extract of Hops, which the inventor denominates "Humuline." August* 15, 1841.

The hops are dried till brittle in an oven heated to 86° Fahrenheit, and are then passed through a coarse sieve; this powder is placed in a close cylinder and covered with alcohol to a depth of one and a half inches, and submitted to pressure for twenty-four hours. The alcoholic tincture is then drawn off into a tub, and the powdered hops washed repeatedly in water, till no further extract remains in them.

The alcoholic tincture, and the essential oil which is combined with it, is placed in a water-bath, and the alcohol driven off, which leaves the essential oil remaining behind in the form of a brownish-yellow resin covered with a yellowish watery extract. This extract is added to the aqueous solution, and evaporated by an open fire to the consistence of sirop; it is then removed to the water-bath and evaporated to a nearly solid extract. This extract is added to the resinous matter of the alcoholic tincture in a warm state, and the compound thus produced is the "Humuline," two pounds of which are equal in use to six pounds of hops.

Another mode is to place hops, either powdered or whole, in a closed vessel, and expose them to the action of steam, when a liquid extract is obtained, which, by evaporation, may be converted into "Humuline."

The claim is to the methods herein described, of making or producing a concentrated extract of hops. Ibid.

Specification of a Patent granted to James Ransome and Charles May, *of Ipswich, Suffolk, for improvements in the Manufacture of Railway Chairs, railway and other pins or bolts, and in wood fastenings and tree nails. August* 15, 1841.

These improvements in the manufacture of railway chairs, consist in the employment of metal side plates in the sand mould in which the chair is cast; and also in using metal cores for the cavity in the chair which receives the rail.

The second improvement, relating to the manufacture of wooden pins or bolts, consists in forcing them into moulds, (which are cylindrical tubes slightly tapered towards the mouth,) and submitting them while under compression, to the action of heat, until the natural elasticity of the wood is sufficiently overcome. The pins will then retain the form thus given them until driven into damp sleepers, when the moisture will cause them to swell, and they will become firmly fixed therein. The wood fastenings and tree-nails are treated in a similar manner.

The claim is—1. To the mode of casting railway chairs by means of metal side surfaces in sand moulds, with metal or other cores as described.

2. To the mode of casting railway chairs, by applying metal cores as described.

3. To the mode of manufacturing railway and other pins or bolts, and wood fastenings and tree-nails, by forcing them into moulds so formed as to retain them under compression till the elasticity of the wood is sufficiently overcome.

4. To the mode of manufacturing railway and other pins or bolts, and wood fastenings and tree-nails, by subjecting them to heat when under compression, in moulds as described. Ibid.

Specification of a Patent granted to James Whitelaw and George Whitelaw, *of Glasgow, for a new mode of Propelling Vessels through the water, with certain improvements in the steam-engine when used in connexion therewith, part of which improvements are applicable to other purposes. August* 15, 1841.

This new mode of propelling, consists in forcing air through openings in the bottom of the vessel, which passes in divided currents along channels or spaces inclining upward from the bottom of the vessel toward the stern, where it escapes at the surface of the water. The propelling power is derived from the buoyancy of the air—the force which it gives out, as it expands in its passage to the surface of the water—and the force from reaction which is communicated to the

vessel as the air escapes. In order to back the vessel, the air is forced out through pipes directed towards the bow of the vessel.

The improved steam-engine consists of a horizontal cylinder through the centre of which a main shaft passes, carrying two vibrating vertical fans, which together fill the diameter of the cylinders, and greatly resemble a Bramah's pump. On one side of this cylinder is another of equal size, and similarly constructed, which forms the air-pump for propelling the vessel, while on the opposite side is the air-pump of the steam-engine. The shafts are all connected so as to move together. On admitting steam to the engine, the fans make a vibratory movement, each motion of the air-pump forcing a portion of air into the channel before mentioned, along which it passes in broken currents, which the patentees consider more advantageous than a continuous current of air. Ibid.

Specification of a Patent granted to THOMAS WILLIAM BOOKER, *of Melin Griffith's Works, near Cardiff, for improvements in the Manufacture of Iron. August* 21, 1841.

For the purpose of converting cast iron from its crude state, into wrought or malleable iron, an open refinery, or furnace, is connected with a reverberatory, or puddling furnace, by a passage which terminates in its neck. The refining furnace having been sufficiently heated, a charge of about nine hundred weight of cast-iron is thrown in, and melted down in the ordinary way; when the refining process is complete, the whole charge of metal is run off into the puddling furnace, previously heated to a proper degree. The iron is then puddled in the usual manner, and divided into lumps or balls of a convenient size, which are passed to the rolling cylinders, &c., to be finished.

The principal novelty in the process consists in causing the heated metal of the refining furnace to pass directly into a puddling furnace without being permitted to become cold. Ibid.

Progress of Civil Engineering.

Baldwin's Geared Truck Locomotive Engine.

Through the kindness of Mr. Baldwin, we are enabled to lay before our readers in the present number, an engraving of this new arrangement of the machinery of a Locomotive, by means of which, the wheels of the leading truck (so valuable in a curved way) are converted into drivers, without interfering with their other useful properties.

We also subjoin the letter of the Superintendent of the Reading railroad, describing a large performance made by this Locomotive on that railway; and at page 178 we insert the report of the committee of Science and the Arts, upon the merits of the peculiar arrangement of parts, by which the adhesion of all the wheels is obtained.*

* For the specification of Mr. Baldwin's patent, for the mode of accomplishing this object, see the number of this Journal for February, 1842, page 136.

PHILADELPHIA, February 12, 1842.

Messrs. BALDWIN & VAIL; Gentlemen,—I send you inclosed, a statement of the performance of your new six wheeled, geared engine, which you will perceive is in every way satisfactory. The train weighed 108½ tons, of 2,240lbs., more than that hauled by your "Hichens and Harrison" engine in February last, on our road.*

Statement of the performance of a six wheeled engine, built by Messrs. BALDWIN & VAIL, *on the Philadelphia, Reading and Pottsville Railroad, February* 12, 1842.

This engine has six wheels and outside connexions. The large drivers (forty-four inches in diameter,) are behind the fire box, and connected with the four truck wheels, (thirty-three inches in diameter,) by cog gearing, in such a way as to obtain the adhesion of the whole weight of the engine, with little additional friction, and at the same time allow the requisite play in curves.

Her weight, in running order, is 30,000lbs.; on her large drivers, 11,775lbs.; or 5,887lbs. on each. On the truck wheel 18,225lbs. or 4,565lbs. on each, and her cylinders are thirteen inches diameter and sixteen inches stroke.

This engine hauled, on the above date, a train of 117 loaded cars, weighing in all 590 tons, from Reading to the inclined plane, on the Columbia railroad, fifty-four miles, in five hours and twenty-two minutes, being at the rate of over ten miles per hour the whole way.

She consumed $2\frac{6}{10}$ cords of wood, and evaporated 3,110 gallons of water, with the above train. Weight of freight, 375 tons, of 2,240lbs.; consisting of 259 tons of coal, twenty-two tons of iron and nails, and ninety-four tons of sundry other merchandize, including fifty-three live hogs, ten hhds. of whiskey, 188 bbls. flour, ship stuff, butter, &c. Weight of cars, 215 tons, making a total weight, not including engine and tender, of 590 tons of 2,240lbs.

Whole length of train, 1,402 feet, or eighty-two feet over a quarter of a mile. The above train was transported in the ordinary freight business of the road, and was run without any previous preparation of engines, cars or fuel for the performance. The engine was closely watched at all the starts of the train, and not the least slipping of any of her wheels could be perceived. She worked remarkably well throughout the trip, turning curves of 819 feet radius, with ease to her machinery, and no perceptible increase of friction in her gearing. Her speed with the train on a level, was found to be nine miles per hour.

Whole length of level, over which the above train was hauled, twenty-eight miles; longest continuous level, $8\frac{1}{10}$ miles; total fall, from the point where the train was started to where it stopped, 210 feet.

The above train is unprecedented in length and weight, in Europe or America. G. A. NICHOLLS,

Superintendent of transportation on the Philadelphia, Reading, and Pottsville railroad.

U. S. Gazette, Feb. 14th.

* See the number of this Journal for May, 1841, page 319.

Cadwallader Evans' Safety Valve.

Letter from Professor Joseph Henry.

Princeton, N. J., Feb. 25th, 1842.

C. Evans, Esq:

Dear Sir:—I have deferred answering your letter relative to your Safety Apparatus until I could find time to make some experiments with the model you sent me, but I have been unable to give the subject any attention until within a few days past.

I have for the last few years been in the habit of mentioning to my class the advantages of using the fusible metal inclosed in a tube surrounded by the steam, for the purpose of setting off an "alarm" in case of the undue heating of the boiler, as proposed by my friend, Professor Bache; but I was not aware of the fact, until I was informed of it by Professor Bache himself, that you had independently applied the same principle to set in operation a self-acting apparatus for relieving the safety valve in case of danger.

I have made a number of experiments with your apparatus, the results of which are perfectly satisfactory. To determine if the discharge of the steam always takes place at the same pressure, the composition of the fusible metal remaining the same, I attached to the boiler a manometer gauge, and found that in each case the discharge took place at about a pressure of thirty-three pounds per square inch. The indications of the gauge did not vary from this more than a pound on either side in any of the experiments, although the quantity of water in the boilers was not precisely the same in all cases. I also have made some experiments on surcharged steam; for this purpose the water was suffered to get low in the boiler, and then the fire was removed from the bottom to the sides, so as to heat the metal above the water line, and surcharge the steam. Under these circumstances the fusible metal gave way at a pressure of about sixteen pounds.

These results appear so satisfactory, that I do not hesitate to state that I consider the plan of using the fusible metal, inclosed in a tube, exposed to the steam, and your arrangement for relieving the safety valve at the approach of danger, as the best contrivance which has been proposed to the public as a means of preventing the disastrous explosions from steam. With my best wishes for your success in introducing your invention into general use,

I remain respectfully yours, &c.,

Joseph Henry.

Observations on the effect of wind on the Suspension Bridge over the Menai Strait, more especially with reference to the injuries which its roadways sustained during the storm of January 1839. *By* W. A. Provis.

From the Proceedings of the Institution of Civil Engineers.

In the month of December, 1825, when the original construction of the bridge was nearly completed, several severe gales occurred, and

considerable motion was observed, both in the main chains and in the platform of the carriage ways. It appeared that the chains were not acted upon simultaneously, nor with equal intensity; it was believed, therefore, that if they were attached to each other, and retained in parallel plains, the total amount of movement would be diminished. On the 30th of January, and on the 6th of February, 1826, some heavy gales again caused considerable motion of the chains and roadway, breaking several of the vertical suspending rods, and of the iron bearers of the platform. These bearers were constructed of wrought iron bars, overlapping each other, and bolted together, with the ends of the suspending rods between them, for the purpose of giving stiffness to the structure. The flooring planks were bolted to the bearers, and notched to fit closely round the suspending rods, which were thereby held almost immovably in the platform. It was observed, that the character of the motion of the platform was not that of simple undulation, as had been anticipated, but the movement of the undulatory wave was oblique, both with respect to the lines of the bearers, and to the general direction of the bridge. It appeared that when the summit of the wave was at a given point on the windward side, it was not collateral with it on the leeward side, but, in relation to the flow of the wave, considerably behind it, and forming a diagonal line of wave across the platform. The tendency of this undulation was, therefore, to bend the bearers into a form produced by the oblique intersection of a vertical plane with the surface of the moving wave. The bearers were not calculated to resist a strain of this nature; they therefore were fractured, generally through the eyes on each side of the centre foot path, at the point of junction with the suspending rods, which being bent backwards and forwards where they were held fast at the surface of the roadway, were in many instances wrenched asunder also. The means adopted for repairing these injuries, and for preventing the recurrence of them, were, placing a stirrup, with a broad sole, beneath each of the fractured bearers, attaching it by an eye to the suspending rod, cutting away the planking for an inch around the rods, and at the same time bolting, transversely, to the underside of the roadway, an oak plank, fifteen feet long, between each two bearers, for the purpose of giving to the platform a greater degree of stiffness, combined with elasticity, than it previously possessed. The four lines of main chains were also connected by wrought iron bolts passing through the joint plates, placed horizontally between the chains. The effects of these alterations and transversely hollow, cast iron, distance pieces were so beneficial, that little or no injury occurred for nearly ten years. On the 23d of January, 1836, a more than usually severe gale caused violent undulation of the platform, and broke several rods. There can be little doubt that ten years' constant friction, combined with the shrinking of the timber, had relaxed the stiffness of the platform, and permitted an increased degree of undulation. The gate-keeper described the extreme amount of the rise and fall of the roadway in a heavy gale to be not less than sixteen feet; the greatest amount of motion being about half way between the pyramids and the centre of the bridge. In conse-

quence of the injuries sustained during this gale, the author and Mr. Rhodes were instructed to give in a report upon the state of the bridge, and on any repairs or additions which might appear desirable. The result of the examination was satisfactory; the whole of the masonry, the main chains, their attachments to the rock, the rollers and iron work upon the pyramids, and all the principal parts of the bridge, was as perfect as when first constructed; it was, however, recommended, "that a greater degree of rigidity should be given to the roadways, so that they should not bend so easily under vertical pressure." The bridge remained in the same state until the hurricane of the 6th and 7th of January, 1839; during the night of the 6th, all approach to the bridge was impracticable; the bridge-keeper, however, ascertained that the roadways were partially destroyed; and he in consequence traversed the strait in a boat in time to prevent the down mail from London driving on to the bridge. When the day broke, it was found that the centre foot path alone remained entire, while both the carriage ways were fractured in several places. The suspending rods appeared to have suffered the greatest amount of injury; out of the total number of 444, rather more than one-third were torn asunder; one piece, 175 feet long, of the north east carriage way, was hanging down and flapping in the wind; much of the parapet railing was blown away; the ties and distance pieces between the main chains were destroyed; the chains had resisted well, in spite of the violent oscillation they had been subjected to, to such an extent as to beat them together and strike the heads off bolts of three inches diameter. Means were immediately adopted for restoring the roadways; and so rapidly was this effected, that in five days carriages and horses passed over, while foot passengers were not at any time prevented from crossing. The opinion of Colonel Pasley, "that all the injuries which have occurred to the roadways of Suspension Bridges must have been caused by the violent action of the wind from below," is examined, and reasons given for the author's dissent from that opinion. The action of the wind upon the Conway and Hammersmith Bridges, is next examined; and from the amount of oscillation observed in all suspension bridges, the conclusion is arrived at, that winds act strongly and prejudicially on the fronts as well as on the horizontal surfaces of the platforms of suspension bridges, and that the effect of winds is modified and varied by the nature of the country, and the local circumstances connected with each individual bridge. Although differing in opinion from Colonel Pasley as to the general cause of injury to suspension bridges, the author agrees with him in the propriety of giving increased longitudinal rigidity to their platforms, to prevent or to restrict undulation. He advised its adoption in 1836, and applied his plan of stiffening by beams in 1839. He preferred beams to trussed framing, on account of the facility with which the former could be increased in number, to obtain any requisite degree of stiffness, and because he feared that trussed frames could not always be kept firmly in their true vertical positions.

Mr. Cowper was of opinion, that the real cause of injury to suspension bridges was the vibration of the chains and roadway. The

whole of the suspended part, when acted upon by the wind, became in some measure a pendulum; and if the gusts of wind were to recur at measured intervals, according either with the vibration of the pendulum, or with any multiples of it, such an amount of oscillation would ensue as must destroy the structure.—Mr. Brunel agreed with Mr. Cowper in his opinion of the cause of injury to bridges, and with the propriety of applying brace-chains, for preventing the vibration. He then alluded to the introduction of lateral braces in the bridge designed by Mr. Brunel, Sen., for the Isle of Bourbon. He had been at the Menai Bridge during a severe storm, and had particularly noticed the vibration of the chains, with the accompanying undulation of the platform. The force of the wind was not apparently from beneath; it appeared to act altogether laterally. The chains were too high above the roadway; their vibration commenced before the platform moved; the unequal lengths of the suspension rods then caused the undulating motion. His attention had latterly been much given to the subject, on account of the Clifton Suspension Bridge, now erecting under his direction. The span would be seven hundred feet, and the height above the water about two hundred feet. He intended to apply the system of brace chains at a small angle to check vibration. To two fixed points in the face of one pyramid would be attached two chains, each describing a curve horizontally beneath the platform, touching respectively the opposite sides of the centre of the bridge, and then extending to similar points on the other pyramid; there they were attached to two levers, the ends of which were connected with a counterbalance of about four tons weight applied to each; these weights would hold the chains sufficiently extended to enable them to resist the lateral action of the strongest winds, without their being so rigid as to endanger any part of the structure. By this contrivance, the platform would be kept firm, which was the chief point to be attained. In all suspension bridges the roadways had been made too flexible, and the slightest force was sufficient to cause vibration and undulation. The platform of the Clifton Bridge would have beneath it a complete system of trough-shaped triangular bracing, which would render it quite stiff. He was an advocate for bringing the main chains down to the platform, as at the Hammersmith bridge, and for attaching the bearers to the chains at two points only; when they were suspended by four rods, it not unfrequently happened, that the whole weight of a passing load was thrown upon the centre suspension rods, and the extremities of the bearers were lifted up and relieved from all pressure. The extent of the expansion and contraction of the chains was a point of importance. In the Menai Bridge, the main chains on a summer day would be as much as sixteen inches longer than in a winter's night. At the Clifton Bridge the difference under similar circumstances would be about twenty inches. The whole expansion of the back chain beyond the pyramids must be thrown into the suspended part. He would prefer having only one chain on each side of the bridge, and that chain much stronger than is usually adopted, but in deference to public opinion he had put two; he believed that they rarely expanded equally, and hence an unequal distribution of the weight of

the roadways upon the suspension rods occurred. A rigid platform would in some degree prevent this, but he had endeavoured to lessen the effects of unequal expansion by arranging a stirrup at the top of each suspending rod, so as to hold equally at all times upon both the chains, and thus cause each to sustain its proportion of the load.

Athenæum, May, 1841.

Description of a Coffre Dam used in Excavating Rock from the Navigable Channel of the River Ribble. By D. Stevenson.

The navigation of the Ribble being much impeded by natural bars or weirs of sandstone rock, compact gravel, or loose sand, several ineffectual attempts were made to remove these hindrances, and eventually Messrs. Stevenson and Sons (of Edinburgh) were consulted, and under their directions the present works were commenced. About half a mile below Preston, a bed of sandstone rock, upwards of 300 yards in length, stretches quite across the river; the higher parts are frequently left dry during the summer months. This natural weir exerts such an influence upon the flow of the tides, that neap tides which at twelve miles distance rise 14 feet, are not at all perceived at the quay at Preston. It was proposed to cut a channel through this bar, affording an average navigable depth of 20 feet at high water of spring tides. In some places, therefore, the excavation would be 13 feet six inches deep. After consideration it was determined to make use of a series of coffre dams, as the most effectual and economical mode of proceeding. Their construction may be thus briefly described:—A double row of wrought-iron bars, 2½ inches in diameter, with *jumper* points worked upon them, were inserted vertically into the rock at regular intervals of 3 feet apart laterally, the second row being placed 3 feet behind the front row. When a sufficient number of bars were fixed, a tier of planking, 3 inches thick, with clasps to enable the planks to be fixed to the rods, was placed withinside. The lower edges of the planks were cut out roughly to the inequalities of the rock; they were then lowered, and by means of an iron rod, with a crooked end, those parts which did not touch the bottom were ascertained, and a change in the form made, until the plank rested its whole length on the rock: the lower edge was then beveled off, and being finally lowered to its place, the plank was beaten down by the force of a heavy mallet, upon an upright piece of wood resting upon the upper edge of the planks; the lower beveled edge yielding to the blows, sunk into the irregularities of the rock, and thus ultimately, in connexion with the puddle behind it, formed a perfectly water-tight joint. The lower planks being fixed, the upper ones were placed upon them; transverse tie bars were inserted at intervals; and the clay puddle was formed in the usual manner. In order that the navigation of the river should not be impeded, the diagonal stays were all placed inside the dams. These stays had joints at the upper ends, and being slipped over the tops of the iron rods, and kept in their places by cotters, their lower ends could be moved either horizontally or vertically, as the irregu-

larity of the rock required:—as the excavation proceeded, longer stays were easily substituted, by merely removing the cotter, sliding up the short stay, and replacing it by another suited to the increased depth. The sides of the dam were kept together by bars of iron connected to two horizontal wale pieces, 10 inches by 6 inches, placed on the outside of the vertical iron rods. When the dam was thus constructed, the water was pumped out by a steam engine of ten-horses power. The whole of the excavation, which was 300 yards in length, and 100 feet in width, was to be completed with three lengths of coffre dams, so contrived as to include within the second stretch the lower side of the first dam, in order to excavate the rock in which that row of piles was fixed. The first and second lengths have been executed; the third is now in progress, and the excavation is proceeding very rapidly. The sandstone rock does not require gunpowder. The total quantity to be excavated is estimated at 31,000 cubic yards. Some doubt existed in the mind of the engineer as to the security of the fastening of the iron rod piles by merely jumping them from 15 to 18 inches into the rock; they have, however, proved to be perfectly firm during heavy floods, when the whole dam has been submerged, and the velocity of the current which was rushing over it was not less than five miles per hour.

Ibid, July, 1841.

Canal Navigation.

Hitherto, the suspension of trade on all canals, when covered with ice of a very trifling thickness, was considered unavoidable; but it has now been satisfactorily established, by the plan adopted on the Forth and Clyde canal during the late storm, that the obstruction, so far from being insuperable, can be completely remedied. The canal Company, and the traders on the canal, are indebted for this improvement to the ingenuity and persevering exertions of Mr. Robert Wilson, one of the overseers, by whom the plan was proposed and carried into execution. The object was effected by means of strongly constructed ice-breakers. By the plan adopted during the late frost, the extraordinary sight of fleets of twenty vessels attached to ice-breakers, and drawn by sixty horses, was daily to be seen passing along the Forth and Clyde canal, through ice from six to ten inches in thickness, at the rate of two miles an hour; and the extent of the benefit conferred on the trade is illustrated by the fact, that, in many instances, vessels which were towed by the ice-breaker from Port Dundas to Grangemouth, made their voyages to London, Hull, and Newcastle, returned with a new cargo to Grangemouth, and were taken back, along the canal by the ice-breakers to Port Dundas, during the continuance of a single frost. The importance of this subject to all owners of, and traders on, canals is so great as to call for the utmost publicity, in order that the improvement may be generally adopted throughout the country.

Railway Magazine, April, 1841.

METEOROLOGICAL OBSERVATIONS FOR DECEMBER, 1841.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	18°	34°	30.25	30.30	W.	Moderate		Clear.	Clear.
	2	22	43	30.27	30.26	W.	do		Clear.	Cloudy.
	3	33	42	30.10	29.80	E.	do		Rain.	Rain.
	4	46	52	29.36	29.30	W.	Blust'ring	1.77	Cloudy.	Cloudy.
☽	5	36	36	29.30	29.30	W.	do		Cloudy.	Cloudy.
	6	33	40	29 50	29.56	W.	Moderate		Clear.	Cloudy.
	7	28	35	29.85	29.93	NW.	do		Clear.	Clear.
	8	24	40	30.10	30.10	W.	do		Clear.	Clear.
	9	39	49	29.90	29.80	SW.	do		Cloudy.	Cloudy.
	10	38	52	29.80	29.70	W. S.	do		Cloudy.	Rain.
	11	47	50	29.35	29.35	W.	do	.21	Cloudy.	Cloudy.
⊗	12	42	48	29.76	29.86	NW.	do		Clear.	Clear.
	13	31	47	30.10	29.98	NW.	Calm		Clear.	Cloudy.
	14	47	50	29.65	29.65	W.	Moderate		Rain.	Clear.
	15	38	52	29.90	29 90	SW.	do	.55	Clear.	Lightly cloudy.
	16	42	43	29.77	29.50	E.	Brisk		Rain.	Rain.
	17	34	32	29.40	29.40	NE.	do	1.10	Rain.	Snow.
	18	19	23	29.95	29.64	NW.	do	.55	Cloudy.	Partially cloudy.
	19	18	30	30.00	30.10	NW. W.	Moderate		Clear.	Cloudy.
☾	20	24	36	30.00	30.00	W. E.	do		Clear.	Lightly cloudy.
	21	26	30	29.95	29.95	E.	do		Cloudy.	Cloudy.
	22	13	20	30.55	30 55	E.	do		Clear.	Clear.
	23	22	32	30.45	30.25	NE.	do		Cloudy.	Rain.
	24	38	35	29.75	29.95	W.	do	1.80	Clear.	Clear.
	25	24	32	30.00	30.00	W. NE.	do		Cloudy.	Cloudy.
	26	18	30	30.10	30.05	SW.	do		Clear.	Clear.
	27	20	30	30.26	30.20	W.	do		Clear.	Clear.
☺	28	28	38	30.15	30.14	SE. S.	do		Snow.	Cloudy.
	29	30	40	30.25	30.27	NW.	do	.10	Por. Cloudy.	Clear.
	30	32	35	30.22	30.10	E. NW.	do		Cloudy.	Cloudy.
	31	29	38	30.10	29.96	W.	do		Par. Cloudy.	Cloudy.
		30.29	38.52	29.93	29.89			6.08		

Thermometer.
Maximum 52.00 on 4th, 10th, 15th. } Mean, 34.405.
Minimum 13.00 on 22nd.

Barometer.
Max. 30.55 on 22nd. } Mean 29.91
Min. 29.30 on 4th 5th.

JANUARY, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	30°	40°	30.10	30.00	W.	Moderate		Clear.	Clear.
	2	33	49	29.70	29.50	W.	Brisk		Cloudy.	Hazy.
☽	3	17	22	29.94	30.00	W.	Moderate		Clear.	Clear.
	4	32	43	29.70	30.16	W.	Brisk		Cloudy.	Cloudy.
	5	22	30	30.16	30.26	W.	Calm		Clear.	Cloudy.
	6	19	34	30.40	30.25	E. SE.	do		Cloudy.	Cloudy.
	7	38	40	29.65	29.65	W.	do	.48	Rain.	Rain.
	8	30	37	30.00	30.15	E.	do		Cloudy.	Cloudy.
	9	36	47	29.95	30 00	W.	Moderate		Cloudy.	Clear.
	10	33	34	30.15	30.10	E.	do		Hazy.	Snow.
⊗	11	31	38	30.05	29.95	NE.	do	.33	Cloudy.	Snow.
	12	29	40	29.76	29.76	W.	do		Clear.	Clear.
	13	27	26	30.00	30.15	W.	do		Clear.	Clear.
	14	18	41	30.00	29.75	E. SW.	Brisk		Clear.	Cloudy.
	15	34	27	29.80	29.83	W.	do		Par. cloudy.	Par. cloudy.
	16	28	35	29.75	29.75	S.	Moderate		Cloudy.	Cloudy.
	17	31	42	30.00	29.95	SW.	Brisk		Cloudy.	Clear.
	18	30	50	29.95	30.00	SW.	Moderate		Clear.	Clear.
☾	19	32	51	29.96	29.90	SW. S.	do		Clear.	Clear.
	20	36	59	29.80	29.75	S.	do	.05	Fog.	Rain.
	21	43	42	29.40	29.40	W.	Brisk		Clear.	Flying clouds.
	22	30	33	29.80	29.80	W.	do		Flying cl'ds.	Flying clouds.
	23	18	23	30.30	30.35	NW.	Moderate		Clear.	Clear.
	24	13	24	30.50	30.50	NW.	do		Clear.	Clear.
	25	24	39	30.00	30.00	SW.	do		Cloudy.	Cloudy.
☺	36	28	45	29.80	29.70	SW.	do		Clear.	Lightly cloudy.
	27	36	36	30.05	29.95	W.	Blustery		Cloudy.	Clear.
	26	22	31	30.28	30.28	SW.	Brisk		Clear.	Clear.
	29	42	55	29.90	29.80	W. S.	Moderate		Cloudy.	Lightly cloudy.
	30	42	50	29.80	29.90	W.	Blustery		Clear.	Clear
	31	42	57	29.75	29.75	SW.	Moderate	.08	Cloudy.	Rain.
		29.87	39.42	29.95	29.94			0.94		

Thermometer.
Maximum 59.00 on 20th. } Mean 34.645.
Minimum 13.00 on 24th.

Barometer.
Maximum 30.50 on 24th. } Mean 29.945.
Minimum 29.40 on 21st.

BALDWIN & VAIL'S ENGINE FOR BURDEN.

JOURNAL

OF

THE FRANKLIN INSTITUTE

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State of Pennsylvania,

AND

MECHANICS' REGISTER.

APRIL, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. By L. Klein, *Civil Engineer.*

[CONTINUED FROM PAGE 149.]

5. *Vienna and Raab Railroad.*

If the northern railroad is distinguished by its great extent, another railroad, beginning also at Vienna, and taking a southern direction, is remarkable for the grandeur of style in which it is executed. This is the Vienna and Raab railroad now opened and in operation to Neustadt, thirty miles, and in progress to Glocknitz, seventeen miles. As its name denotes, one direction to be taken by this railroad is to Raab in Hungary, and it is proposed to touch Presburg also, and to be continued from Raab to Buda, the capital of Hungary. Another project is the continuation of the line from Glocknitz, the present southern terminus, through Styria and Illiria to Trieste, the important Austrian sea port. Even if only one of these extensions should be carried into execution, this railroad must be regarded as one of the most gigantic undertakings on the continent.

The company of the Vienna and Raab railroad was formed in 1838; in April, 1839, the works were commenced on the section between Vienna and Neustadt; part of the latter was opened on the 16th of May, and the whole on the 20th of June, 1841. The line passes through a beautiful country, highly cultivated, and covered with small towns and villages, along the foot of the picturesque mountains, which

amphitheatrically surround the metropolis. The principal place on the line besides Neustadt, is the watering place of Baden, a favourite resort of the Viennese during the summer. Another interesting place on the line is Moedling, sittiated on the entrance of the beautiful valley called the "Bruhl," whose wild and romantic scenery attracts thousands from the city every Sunday.

With such attractions for the public, the company calculated on a million of passengers per year, and the results of their operations have thus far proved the correctness of this calculation. They resolved, in the anticipation of a considerable revenue, to construct their road on the most approved plans, to make the buildings and other structures on the line such, that they may serve to embellish the environs of the city, and to provide the road with the best engines and cars.

The Directors and Engineer seem, however, to have transgressed the limits which a prudent economy and due regard to the interest of the Stockholders should have prescribed them; but before I point out some of the errors, which have been committed, I shall try to give a short description of the road.

The principal depot, or station, is outside of the barriers of the city and its suburbs, and distant nearly two miles from the centre of the former; passing a considerable distance along the southern suburbs, it crosses the turnpikes which lead to Laxenburg, Italy, Hungary, &c., on viaducts, avoids the Vienna hill, and approaches the mountains, on the foot of which it continues in a southern direction to Baden and Neustadt. From Neustadt to Glocknitz the line goes nearly straight to the south-west. The maximum grade between Baden and Neustadt is 18.4 feet; between Vienna and Baden thirteen feet, and between Neustadt and Glocknitz 40.6 feet per mile. The smallest radius of curvature on the whole line is 6,222 feet (6,000 Vienna feet.)

Between Vienna and Neustadt the railroad has been graded for a double track; the width of the road bed is twenty-nine feet; the excavations were made fifty-six feet wide on the bottom, to leave ample room for ditches, which are three and a half feet deep. The slopes are one and a half to one, and on some places two to one. Several high embankments and deep cuts were required to give the proper level on the located line. The highest embankment is 46½ feet, there are others of 41½ feet, 40½ feet, and thirty-two feet in height; the deepest cut is thirty-seven feet, partly in rock; 380,000 cubic yards of materials have been removed from this cut alone. The contents of excavations and embankments between Vienna and Neustadt is 4,500,000 cubic yards, and the average cost was seven cents per yard.

Of 136 road crossings, seventy-five are at the level of the railway, for the other sixty-one, bridges were constructed partly under and

partly over the railroad; amongst the latter is a lattice bridge of 125 feet span, the first one, I believe, executed in Germany. One hundred and twelve bridges and culverts were erected over streams and brooks, besides ninety small culverts of stone or wood for road crossings, &c. Many of the bridges are of large spans, or have oblique arches; at Baden there is a viaduct with forty-seven arches and 1431 feet in length.

A tunnel of 541 feet in length, twenty-nine feet wide, and twenty-five feet high, entirely arched with cut stones, belongs also to the interesting structures on the line. This tunnel has been built at an expense of 50,000 dollars, and is the first constructed in Austria. Having mentioned the principal works executed to bring the road bed to the proper level, I shall now briefly describe the superstructure:

Over the whole width of the road bed, in excavations as well as upon embankments, a layer of gravel, two feet thick, has been spread; cross-ties, twelve inches broad and four inches thick, were laid four feet apart, and longitudinal sills, nine inches broad and four inches high, fastened upon them with screw bolts; these sills serve as continuous supports to the iron H or ⊥ rail, weighing 52 lbs. per yard, which is kept fast by screws, the heads of which overlap the base of the rail. To effect a better contact, hair felt has been put between the base of the rails and the longitudinal sills. The ends of the rails, which are square, rest in flat chairs, weighing 12 lbs; the cross-ties and sills are of oak timber, and have cost thirty-five cents per cubic foot; the rails have cost 117 dollars per ton (2240 lbs.) delivered on the road, and the expense for the whole superstructure was 13,500 dollars per mile of single track. The railroad has a double track, and on account of the many stopping places, the sidings have besides a length of eight and a half miles. The width of track is four feet eight and a half inches.

The buildings erected on the Vienna and Raab railroad are both numerous and elegant. At the terminus at Vienna, the road is elevated seventeen feet above the natural surface of the ground, in order to let the turnpike roads pass under it; the passenger hall, where the passengers start and arrive, is therefore, in the second story of a large building, 385 feet long and ninety feet wide, covered with a free roof of this span. Below are the ticket offices, baggage room, &c., and two flights of stairs, one for the passengers who start, the other for those who arrive, lead to the waiting rooms and the cars. Near this building is the establishment for constructing and repairing locomotives and cars, surpassing in regard to its extent and machinery all others of this kind on any railroad. The whole establishment consisting of a large machine shop, a foundry, boiler shop, car houses, &c., occupies an area of 5000 square yards, and has cost 250,000 dollars.

Two high pressure engines, of twelve horse power each, serve to move the lathes, pump water, &c.; they were like the rest of the machinery imported from England. Last spring the following individuals were employed in this establishment: fifty-eight blacksmiths, eighty finishers, fifteen turners, twenty boiler makers, fourteen founders, sixty one joiners, ninety-nine carriage makers, twenty-six varnishers, thirty-five saddlers, and fifty-seven common laborers, in all 465 men. At the Vienna depot there is also a large building with three stories, serving at the same time as an hotel, and as a dwelling-house for the company's officers, a large watering station for the engines, &c.

Large depots are also at Neustadt, Baden and Moedling, and smaller ones on the numerous intermediate stopping places. At Baden the passenger halls are, like those at Vienna, upon an embankment in the middle of the long viaduct, above mentioned. There are also along the line twenty-eight houses for the men, constantly employed for watching and repairing the railroad, each of which contains a spacious lodging for a laborer with his family, and for some other men, when their assistance on the road should be required. There are in all on the railroad from Vienna to Neustadt, fourteen buildings with two or more stories, fifty-seven do. of one story, and forty-six viaduct stores.

The outfit consists at present in eighty-eight wheeled passenger cars of three different classes, built on the American model; some four-wheeled baggage cars and twenty locomotive engines. Of the latter, eleven are from England, three from Mr. Norris, in Philadelphia, and six were built in the company's own establishment, on the American principle.

The total cost of the railway from Vienna to Neustadt, including the machine shop, amounted to near 3,000,000 dollars, which is at the rate of 100,000 dollars per mile of road with a double track, with buildings, outfit, &c. The capital stock of the company is 6,250,000 dollars. The chief Engineer of the Vienna and Raab railroad is Mr. M. Shoenerer, under whose direction the Lintz and Gmunden, and the southern part of the Lintz and Budweis railroad have been constructed.

Whoever examines the above described railroad more carefully must become convinced, that far too much capital has been expended for objects not at all essential to the success of the undertaking; he finds, that by adopting more frequent changes in the grades, several heavy cuts and embankments could have been avoided; that there was no necessity at all for building a tunnel through a hill, which might have been entirely avoided by locating the line only a hundred yards farther east; that the superstructure is too strong and rigid, destruc-

tive to the cars and engines, and difficult to be kept in repair, on account of the timbers and rails being fastened together by screws; the strength of the rail is sufficient to do away with longitudinal bearing timbers, and a less costly superstructure would also have been the better one. The buildings are all very fine, one may say splendid, but the depots are not at all conveniently arranged for the accommodation of a great number of passengers. Had the buildings been made simpler, the depots, halls, &c., longer and wider, the money would certainly have been more judiciously applied. The eight wheeled cars are a good imitation of the American ones, as regards their appearance, size, arrangement of seats, &c.; but the trucks are badly constructed, the springs are too short, which, aided in part by the hardness of the road, makes the motion very uneasy. The introduction of engines of different manufactures is also no small mistake, which this company makes in common with so many others on the continent.

On the 16th of May, the line from Baden to Neustadt, about fifteen miles in length, was opened, and from that day up to the 28th of May, 1841, there traveled over the road, Passengers, 5,418 Income $1,202

A further section of road from Baden towards Vienna was put into operation on the 29th of May, and to the 19th day of June inclusive, were,	30,667	5,090
On the 20th of June, 1841, the whole line from Vienna to Neustadt was opened, and up to the 31st of July, 1841, there traveled	245,802	59,880
Total,	281,887	$66,172

It appears, therefore, that since the opening of the whole line, the average number of passengers per day has been 5,825, but on Sundays from 12,000 to 15,000 people generally traveled over the road. It may be estimated, that 180,000 passengers per month will use the road in summer, which for six months, would give already over one million. But we see at the same time, that the average receipt per passenger amounted only to 23¼ cents,* and a million of passengers will therefore yield an income of only 235,000 dollars, which compared with the cost of construction, is short of eight per cent. Deduct one half as the expenses of operation, and there will remain only four per cent. as interest on the capital invested.

Such are the prospects of this railroad, which, if constructed with more economy, would have become the most productive in the mon-

* The passenger fare is one and three-fifths cent in the third class, two and one-third cents in the second, and three cents in the first class cars. The tickets for the different classes have different colours, corresponding to the colours of the cars.

archy. It is now dependent on a million of passengers per year, to yield a dividend of four, perhaps four and a half per cent. The stock is now sold at twenty-five per cent. below par, though the travel on the road exceeds all expectation.

Leaving out of sight the loss sustained by the Stockholders themselves, it must be regretted that the extravagant expenditure in the construction of this railroad, by its influence upon the comparative productiveness, will have a bad effect upon other undertakings of this kind, the accomplishment of which must in a considerable degree depend on the success of existing railroads.

6. *The first Hungarian Railroad, from Presburg to Tyrnau.*

The kingdom of Hungary, the largest province of the Austrian Empire, will also have its railroad communications. Several large projects are on foot, to extend this kind of improvements far into the interior of that vast country: that the Vienna and Raab railroad, above described, is intended to connect Vienna with Buda and Pest, has already been mentioned, as also, that a branch of the Emperor Ferdinand's northern road is to lead to Presburg, the seat of the Hungarian Diet. Of a much larger undertaking of a railroad through Hungary I shall have occasion to speak hereafter; the railroad I am now going to describe, is of minor importance, and more of a local interest, interesting however, as the first one brought into operation in Hungary. It extends from Presburg on the Danube to Tyrnau, passing some other small towns, and its total length is twenty-nine miles, of which one half is in operation, the other half in progress of construction.

The Presburg and Tyrnau railroad was projected as early as 1836, but the works were not commenced until late in 1839; the first section of the line, from Presburg to St. Georgen, was opened in September, 1840, and another section of five miles, to Boesing, at the end of June last. For this distance of fourteen miles the direction of the line is north-east, along the foot of the Carpathian mountains; it then takes a more easterly course to Tyrnau, where the road terminates.

There are many curves in the line, their smallest radius is 1500 feet; the road is undulating, and the maximum grade is thirty-five feet per mile. Total ascent from Presburg, 167 feet; descent, 119 feet. Line and profile have been chosen, to conform as much as possible to the natural surface of the ground, and to avoid large expenditure for grading and bridging. The superstructure is made according to the same views, that is, with regard to cheapness. Plate rails of two by seven-twelfths inches are fastened upon stringpieces of six by seven inches, which are keyed into cross-ties, formed of half-trees, twelve inches in diameter. The latter rest upon a bed of stones, with which material

all the spaces between the timbers are filled out to within three inches below the surface of the rails; the stones are then covered with a thin layer of gravel or sand, the road being worked by horse power. The track has the common width of four feet eight and a half inches.

The following are some of the average prices, so far as the road has been completed:

For excavating ground and forming embankments, per cubic yard measured only in excavations,	.07	cents.
For stone masonry in bridge abutments, per cubic yard,	$ 1.12	"
" brick masonry, " " "	1.50	"
" " " in arches, "	1.72	"

The cross-ties of oak cost forty-two cents a piece; the sills sixteen cents per running yard; the iron bars sixty-five dollars per ton; the laying down of track, including the formation of horse path, &c., has cost thirty-six cents per running yard of single track.

The expenditure for the part of the road already completed, amounted to 200,000 dollars, and the total cost of the whole line will not exceed 400,000 dollars, which is at the rate of only 13,800 dollars per mile, including buildings, outfit, &c. It is expected that about 100,000 passengers and 40,000 tons of freight (principally wood from the Carpathian mountains) will be transported annually over this railroad; it will therefore undoubtedly become a very profitable undertaking. Nevertheless, it was found very difficult to raise the funds necessary for the completion of the road, when the original capital of 250,000 dollars had been expended; so little confidence was put in the success of the undertaking, that the Directors had to appeal to the generosity, patriotism, and national pride of the Hungarians, to induce them to subscribe for the additional stock to the amount of 150,000 dollars. This stock was finally taken at the time when the shares had nearly no value at all in the market.

The following has been the traffic on the first nine miles of the road, from the opening of the same to the end of May, 1841:

		Income.
No. of passengers from Sept. 28, 1840, to April 30, 1841,	18,344	$ 1,581
" " in May, 1841,	6,788	577
Quantity of freight transported, 32,256 cwt.		575
		$ 2,733

The passenger fare was very low, viz:

			Per Mile.
For 9 miles from Presburg to St. Georgen,	1st class,	12.8 cts,	1.42 cts.
" " "	2d class,	8.0	0.89 "
" " "	3rd class,	6.4	0.71 "

Horse power is exclusively used upon this road; two horses generally take two cars, containing each twenty-four seats, and the distance of nine miles is performed in from fifty to sixty minutes. The whole line from Presburg to Tyrnau is expected to be finished early next year.

7. *Milan and Montza Railroad.*

This was the first railroad undertaken and executed in the Austrian dominions of Italy. The charter for it was granted on the 15th of November, 1839, and the work was executed early in 1840, so that on the 17th of August the line was put into operation. The total length of this road is only eight miles. From the 18th of August to the 31st of December, 1840, the number of passengers conveyed was 158,218, and the income 25,943 dollars.

8. *The Lombardo-Venetian Ferdinand's Road,*

From Venice to Milan, now in progress, was chartered on the 4th of April, 1840, and will have a length of 180 miles. It extends from Venice through the cities of Padua, Vicenza, Verona, Brescia, and Bergam to Milan; the section from Venice to Mestre has been first let, and the greatest work of this, and perhaps of any railroad hitherto executed on the continent, is the bridge over the Lagunes at Venice, which will have 252 arches and a length of 11,870 feet. This bridge was let on the 30th of July, 1840, for 805,000 dollars, for which sum it has to be built so as to serve also for the proposed aqueduct. Should the latter not be required, the stipulated sum is only 750,000 dollars. The cost of the whole railroad is estimated at 9,650,000 dollars, which is equal to 53,611 dollars per mile.

Railroads Projected, but not yet Commenced.

Several important projects for railroads in different provinces of the Austrian Empire have been undertaken in the last two years, with more or less prospect of an early accomplishment. The rumors of war, created last year by the critical state of the Oriental affairs, the stagnation of business, and the distrust in the success of those railroads which have been finished, have much retarded the progress of internal improvements, by preventing capitalists from embarking their money in similar undertakings. As yet, the government has not given any direct aid to railroads by taking stock, lending its credit, or guaranteeing a minimum interest to the Stockholders, as has been done in other parts of Europe. Such an assistance would serve to give a new impulse to enterprise, and insure an early execution to many interesting projects. The following are the railroads projected:

1. *The Bohemian Coal Railroad,* from Pilsen to Budweis in Bohemia, the object of which is the cheap transportation of coal from the rich mines near Pilsen to Budweis, and over the Budweis and Lintz

railroad to the Danube and to Vienna. The total length of this road, for which the surveys and plans have been finished, is 108 miles. Maximum grade, sixty feet per mile; smallest radius of curvature, 1200 feet. Country very broken, and unfavorable for the construction of a railroad. Estimated cost, about 4,000,000 dollars.

2. *The Prague and Dresden Railroad* is intended to connect the capital of Bohemia with that of Saxony, and has been recently projected. It is to unite at Dresden with the Leipsic and Dresden, and at Prague with the Vienna and Prague railroad, which latter will probably be executed by the company of the Emperor Ferdinand's northern road. The country is very hilly and mountainous, and the road confined to the narrow valley of the Moldun and the Elbe. Probable length, 122 miles; the surveys are now making.

3. *The Vienna and Trieste Railroad* is a gigantic project; in its proposed direction from Neustadt (to where the Vienna and Raab railroad extends) through Styria and Illiria, over Gratz and Laibach, it would have a length of 375 miles. There are four principal summits between Vienna and Trieste, on two of which horse power will have to be used. The maximum grade for the remainder of the road is fifty-five feet per mile. Nothing has yet been done towards the execution of this work.

4. *The Central Railroad of Hungary* commences at Presburg and goes along the left bank of the Danube to Pest, from thence in an easterly direction to Debretzin. Total length of main line 330 miles. The surveys for this railroad are made, and a company has been formed with a capital of 4,000,000 dollars, on which five per cent. have been called in. The works have not yet been commenced.

5. *The Railroad from Bochnia to Lemberg* is designed as a continuation of the Emperor Ferdinand's northern road, which terminates at Bochnia to Lemberg, the capital of Galicia, from whence it is ultimately to be continued to Brody, on the frontier of Russia. Distance from Bochnia to Lemberg, 190 miles. The surveys for this road have been recently commenced.

The total length of railroads now in operation in the Austrian Empire is 350 miles, of which 172 miles are worked by horses, and 178 miles by Locomotive engines. There are at present besides 175 miles of railroads under construction, and the total length of all railroads completed and in progress in Austria, is 840 miles; while the aggregate lengths of those railroads, which have been projected, but not yet commenced, is 1,125 miles. The total amount of capital already expended in the Austrian Empire for railroads will be about fourteen millions of dollars.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the use of Piles for Railway Superstructures. By John C. Trautwine, *C. E.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—Since the appearance in the January number of your Journal of my paper on the cast iron rail,* which I contemplate adopting on the Hiwassee railroad, I have received a letter from an esteemed professional friend, for whose opinion I entertain the highest regard, cautioning me in the strongest terms against the use of piles for my superstructure. He assures me that experience, so far as it goes, is entirely against them; and that their adoption on my road, would inevitably be injurious to my professional character.

In support of his opinion, he adds that every Engineer with whom he has conversed on the subject, coincides with him; and I am myself aware that a very general prejudice exists among the profession, not only in the United States, but in England, against employing piles in a railway superstructure. It is therefore with some hesitation that I venture to advance a contrary doctrine against so formidable an array of the fraternity; but after a close and careful investigation of the subject in all its bearings, I feel constrained so to do; having arrived at the conviction, not only that the grounds of prejudice against piles are entirely insufficient to justify their rejection, but that on the contrary, they may, by proper management, be made to furnish a road far less liable to derangement, either *vertically* or *horizontally*, than any of the plans now in common use; and moreover, that they will, where so employed, effect a diminution in the annual expenditures of many of our railroads, of at least 25 per cent.

This conclusion I have arrived at, after carefully comparing the piled superstructure with all the plans in general use, many of which have to a greater or less extent been constructed under my own immediate superintendence, thus affording me a fair opportunity of testing their several defects and advantages, and of instituting a comparison of their respective merits and demerits.

* I will here take occasion to correct two or three errors and omissions which I see have occurred (from the manuscript) in the above mentioned paper. On page twenty-four, four lines from the bottom, instead of "and more than six times as great as would be required to break it," read "and that one six times as great would be required to break it." Also, on second line from bottom, instead of "fifteen tons" for the test load of the rail, read "ten tons." This same error recurs at page twenty-six, six lines from the bottom. There is also an omission of reference to fig. c in the engraving.

Fig. c, represents the centre of the rail, showing the projecting flanges for confining the centre of the rail from longitudinal motion, so as to compel all contraction and expansion, by changes of temperature, to take place from the centre towards each end.

I would earnestly invite such of my readers as are sceptical on the subject, to defer coming to a final decision, until they have resorted to the same process for satisfying their doubts. I suspect that any impartial person who will take this trouble, will acquiesce in the opinions which I advanced in the paper alluded to, viz. that piles will before long supersede all other foundations for railroad superstructures.

Nothing can on reflection be more evident, than that no branch of constructive engineering, of equal importance, is so radically defective, as that of placing the superstructure of a railroad, which essentially requires the adjunct of the most unyielding support, upon almost the very *surface* of the earth, which is, of all foundations the most treacherous.

Instead of presenting a perfectly firm and incompressible basis for the rails, this, in wet weather, actually becomes, to a depth of several inches, so far as regards consistency, and resistance, either *vertically* or *horizontally*, but little better than a bed of mortar, or a layer of quicksand.

Let the reader who needs confirmation of this assertion, watch the progress of a train of loaded cars, over almost any of our railroads, after a few days of rain; when he sees the undulations that take place as the supports are alternately subjected to, and relieved from, the pressure of the engine and cars as they pass, he will more readily coincide with my views, and his only source of surprise will probably be, that the annual expenses for the adjustment of the track, are not more serious than they are. A calculation, which may serve for a moment's amusement, will show that every heavy rain creates an expenditure on a railroad 100 miles in length, of from $1,000 to $3,000.

Were the ground never wet, a railroad superstructure of common construction would answer its purpose admirably; either vertical or horizontal derangement would be almost impossible, and the road would retain its adjustments for years. Every Engineer is, I presume, acquainted with the almost entire resistance to wear, presented by perfectly dry earth; and knows that the most durable turnpike would be made, by merely sheltering from the weather the space it was intended to occupy, without any necessity for a stone covering.

But such an exemption from the action of water is not to be attained in either turnpike or railroad practice; and we are obliged to employ the best methods we can devise for resisting the encroachments of this insidious and powerful enemy.

That this has hitherto been effected, to the extent desirable in practice, no Engineer will assert; on the contrary, the inefficacy of all the plans hitherto resorted to for the purpose, is a source of great and

very serious annual expenditure on every railroad that has been constructed; in some cases absorbing so heavy a proportion of the income, as completely to destroy the character of the road, as an object of pecuniary investment.

The expenses for labour and materials for retaining the adjustments of superstructure, amount, on such of our wooden railroads as are doing a tolerable business, *to an average of about one-half the entire annual expenses of the concern.* It is true, we frequently see this item set down in the reports of Directors and Engineers, at much less than the above proportion; but when this is done, it is generally with reference to *new* roads, on which time for derangements of the track has not yet been allowed. On roads that have come fairly into operation, and are accommodating a good traffic, the above average assumption is tolerably correct, and applies as well to the flat bar road with light engines and moderate velocities, as to the most durable edge-rail road with its heavy engines, moving at high speed. It is scarcely necessary to suggest to any professional reader, the difficulty of attempting to assume *average* proportions in cases like the foregoing. They serve well enough the purposes of the general reader. The Engineer will take them at their worth.

When we reflect that this most serious item of railroad expenditure, is produced by the action of rain and frost, how solicitous should we be to adopt the necessary precautions, to obviate the effects of these agents, so far as lies in our power.

We cannot prevent the occurrence of either rain or frost; but we can place our foundations at a depth to which the action of neither can reach; and, at the surface, where their effects are most powerful, we can oppose to them such materials, and so arranged, as to render their attacks comparatively harmless.

It is common to employ trenches, some fifteen to twenty-four inches in depth, and filled with broken stone, under the immediate supports of our superstructures, whether of wood and iron, or of stone and iron. These trenches perform at least one good office, viz: the drainage of surface water, which would otherwise expedite the decay of the timbers; and to a considerable extent, they diminish the effects of the frost. They are, however, too shallow to remedy the evil resulting from the softening of the earth by rain, which percolating through the broken stone, collects in the bottom of the trench, and reduces the soil to a consistency affording very little *vertical* resistance to the pressure of passing loads, as the undulations after heavy rains fully prove.

It is moreover equally obvious, that the softened earth or mud at the *surface,* is not at all calculated to withstand the horizontal pressure of the trains; especially as they sweep rapidly around the curves, or

lurch violently from side to side on deranged portions of the straight lines. It has, I suspect, come within the observation of most of my professional readers, that on tolerably sudden curves the mere elasticity of the rail, or sometimes of the wooden string timbers, tending to restore themselves to their original straightness, not unfrequently exerts sufficient lateral pressure to overcome the resistance of the earth, and force the superstructure outwards, until it becomes, instead of a continuous curve, a mere series of chords.

I am by no means confident that even trenches filled with *solid concrete*, as now proposed by some, and which appear to meet with pretty general approbation with the profession, will be found entirely to remedy these defects; unless the trenches are deeper than those now commonly used in superstructures. If this precaution be attended to, the percolation of water, and consequently the action of frost, will be to a great degree prevented. But other difficulties suggest themselves in connexion with the use of concrete in this manner, which to me appear insuperable. For instance, the ground under these continuous lines of concrete cannot be expected to be of uniform consistency; and we know that high embankments do not reach their period of final settlement for several years; consequently, the concrete will, in many cases, act the part of a long stone girder, supported only at its ends; and again, it frequently happens that isolated rocks present themselves in the graded surface, which will prevent the centre of a given length of concrete from settling equally with the adjoining parts. Either of these occurrences will inevitably produce fractures, such as frequently occurred in the continuous granite sills of yore. I remarked above, that these difficulties appeared to me insuperable; I should have said, except at an expense that few railroad companies could afford to encounter. I should have no confidence in concrete formed of *common* lime only, for this purpose; and if hydraulic cement be used, the cost of continuous trenches of sufficient size would be enormous.

When we look at the plan of stone-block and edge-rail superstructure, there is even less to commend itself on the score of stability than in the wooden railroads. This is the plan of the Liverpool and Manchester road, and of some roads in the United States, on which the expenses of repairs and adjustments of track are very heavy. This item, of course, must increase with the traffic of the road, but it is also dependent to an equal degree, upon the weight and velocity of the engines. The engines now in common use are certainly too heavy for the superstructures of many of the railroads on which they run, and under such circumstances their introduction is adverse to every principle of true economy.

I confess, that when I first began to consider what could be done by

means of piles, to remedy the defects attending the ordinary methods of superstructure, they seemed to present more formidable obstacles than almost any other plan; and the apparent magnitude of their objectionable features was no doubt augmented by the prejudice which I had entertained against them. But upon reflection, these prejudices vanished. The ordinary plans of superstructure are liable to derangement *both vertically and horizontally;* no one will deny that piles are at least free from the former objection. We have then, in the ordinary plans, *two* movements to guard against; in the piled superstructure we have but *one.*

Nearly all the examples of piled roads in the United States, are either those in which the piles are left extending several feet above ground, as a substitute for embankment, and thus affording a great leverage for the lateral action of trains to operate through, to produce horizontal displacement; or, in other instances, they are driven through a soft superstructure of marsh, quicksand, &c., that their feet may rest on a firm subsoil. This latter case evidently resolves itself to all practical intents and purposes into the former; for the yielding surface stratum affords nearly as free a leverage for producing lateral motion, as if the upper part of the pile were in the air.

Other roads again, have short piles driven their entire length into firm soil; but here they are generally but about three feet in length, and intended as an economical substitute for stone blocks, and are plainly liable to the same derangements as they from rain and frost.

Lastly, piles are sometimes used not as *supports,* but as *stays.* They were, I believe, first employed in this manner by Mr. Brunel, on the Great Western railroad in England; nor do I know that the example has been subsequently imitated on any other roads. Mr. Brunel has placed them in the centre of the track, and the cross-ties are bolted *to their sides.* They are intended only as stays against lateral motion.*

Although somewhat irrelevant to the subject, I will here remark, that this plan of construction appears to me to be essentially defective. Unless the rail-timbers be rendered *absolutely free* from vertical motion, (and this I contend cannot be effected by any plan now in use) a very injurious strain must come upon the cross-ties, which will even-

* Mr. Brunel had another object in view, which constitutes the chief peculiarity of his pile plan of superstructure for the Great Western railway. It was, by employing the retaining power of the piles, to enable him to force sand or gravel beneath the continuous bearings of timber until they cambered, or received *an upward pressure* of about a ton per foot lineal; and Mr. Brunel expected, that the force thus made to act *upwards* against the underside of the continuous bearings, would countervail the pressure *downwards,* produced by the passing trains. (See 3rd English Ed. (1838) Wood on Railroads, p. 718.) COM. PUB.

tually uphold, as it were, the entire superstructure by means of their bolts, for at their ends, they inevitably *must* yield; while at their centre, they quite as certainly *cannot* do so. This defect might readily be obviated by making the bolt hole elliptical, the longer axis being vertical. A vertical motion could thus be allowed, which would not at all interfere with the lateral resistance of the piles.

Here are, I believe, all the plans with which I am acquainted, in which piles have been employed in railroad superstructures; and it is, I suspect, entirely upon the self-evident inefficiency of any of these methods to combine vertical and horizontal stability, that the use of piles has been so universally denounced.

In the course of my own professional studies, I have invariably been more benefited by investigating instances of *failure*, than those of *success;* and it has been chiefly from the failures of piles in all the above cases, to fulfil their intended offices, that I have drawn my conclusions as to their entire efficiency, when so employed as to obviate the objections thus practically pointed out.

One very important collateral advantage resulting from the attainment of perfect stability in the superstructure, will be a diminution in the weight of the rail, which is one of the heaviest items of expense on railroads. The entire freedom from sudden shocks, and from the constant succession of *percussions*, which occur on all railroads of ordinary construction, will not only allow of such a diminution in the weight of rail, but will add greatly to the comfort of passengers, and prevent the injury which experience shows to result to many important articles of traffic, as flour, &c., from the jolting motion on a badly adjusted railroad. This stability will also remove the greatest impediment to the introduction of cast-iron rails; a matter in which not only railroad companies, but American iron masters, are deeply interested.

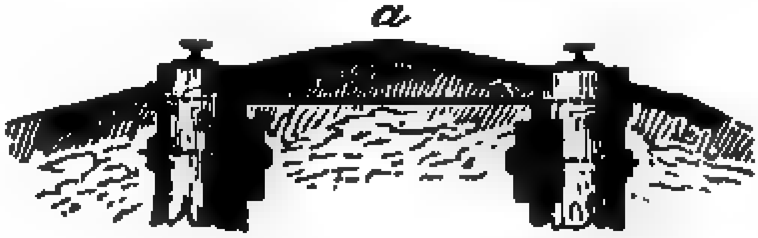
In employing piles as I propose, making them the principal source of immobility in railroad superstructures, two cases present themselves, requiring, or rather admitting of, some variation in the mode of operation. The first case, (which embraces the Hiwassee railroad) is that of a road in a warm climate, where the frost rarely penetrates to a greater depth than from three to six inches; and where the soil, being of a firm gravelly nature, enables us, by curving the road transversely, to confine the softening influence of even long continued rains, also, to a depth of a few inches. I am surprised at the want of attention to this method of drainage, every where observable on our railroads. It is one of the most simple, most perfect, and least expensive of any that can be adopted. Perhaps one half the water that now percolates through the broken stone to the bottom of the trenches could be thus got rid of.

In this case, I suspect, that piles from ten to fifteen inches in diameter, and averaging from six to ten feet in length, placed at intervals of from three to four feet apart from centre to centre, and driven down until their tops are but two or three inches above the surface, and connected transversely either by iron tie-rods, or by wooden cross-ties, would be found to answer every purpose. See figure.

Engineers are so apt to connect the idea of piles, with that of a soft, yielding foundation, that it is difficult to divest themselves of the association. The very term, pile, seems necessarily to involve lateral weakness; but in this case it is not so. Our piles are not supposed to be driven into a marshy soil, but into earth so compact as actually to require holes to be dug previously, through the upper consolidated stratum to a depth of two or three feet, to give them admission, for without this precaution, their driving would prove to be a troublesome business. But when firmly driven, and the soil well compacted around them by heavy rollers, the case more nearly resembles that of the stump of a tree, unyielding in any direction; and admits of no comparison with the instability of a common superstructure, with its base well lubricated with wet unctuous clay.

But let us, for the sake of argument, admit that some additional precautions *should* be found necessary in this instance; how easy would it be to apply it to any required extent, by simply bolting to the piles stout longitudinal pieces as shown in this sketch—*a*.

a



I do not know that it is a matter of much importance on which side of the piles the longitudinal pieces be bolted. We will now take leave of *case No.* 1, merely cautioning the reader once more, to divest himself of all notions of marsh-mud; and to substitute in his mind's eye, a firm, *dry* soil, almost incompressible by any force that can be applied to it. If necessary, a stratum of well rammed McAdam stone might be used to a depth of three or four inches, to facilitate the dis-

charge of rain water from between the rails. Should such a superstructure, in such a climate, and on such a soil, not be found infinitely more unyielding, both vertically and horizontally, than those on the ordinary plans, then will I of a truth exclaim, "peccavi," I have sinned.

Let us now pass on to *case No. 2*; by which I mean nothing more nor less than a railroad in a severe northern climate, where the rain and frost combined, produce a sensible deranging action on superstructures to the depth of about two feet.

Here, there is manifestly no more difficulty in securing the *feet* of the piles, or in other words, in attaining *vertical* stability, than in *case No 1;* the only essential point of difference is to provide for the heads of the piles, a stratum which shall at all times be (practically considered) perfectly dry, and incompressible; and on which the upward action of frost at the bottom of the stratum, shall be comparatively harmless.

b

This desideratum I propose to effect by the very plain process indicated by figure *b*, which represents a transverse section of a continuous trench, about eighteen inches deep and nine feet wide, filled with broken stone, to form the stratum alluded to. At the bottom of the trench, the stone might consist of tolerably large sized spalls; but a thin layer at top should be of McAdam size, to throw off rain as much as possible. After the piles are driven, and the longitudinal pieces bolted on by screw-bolts, the first layer of stone should be put in, and well rolled by a horse-roller; then the cross-ties put on, and the remainder of the stone introduced and finished off by ramming, to conform to the curved line, nearly covering the cross-ties.

My impression is, that the diminished action of the frost at this depth, will loose itself, as it were, among the broken stone; and that the stratum will at all times remain so compact as effectually to prevent lateral motion.

Of course, I do not wish to be understood as confining myself to the above forms of construction in the timber work; it may be modified according to the judgment of the Engineer. I think it probable that a mere covering of McAdam stone well compacted and properly attend-

ed to at intervals, would be found sufficient to keep the *natural* upper stratum dry, and if so, it would be attended by some saving of expense. Neither gravel nor sand would in my opinion answer as a substitute for broken stone for filling the trenches. The former would admit of compression from the roundness of its particles; and the latter, by becoming saturated with rain.

All I desire is to establish the supremacy of a piled superstructure over others hitherto employed. If my poor efforts in its behalf, accomplish nothing more than to induce the profession maturely to weigh its claims to a preference, I shall have accomplished my principal object in writing this paper; for I feel convinced that their so doing, will lead to its adoption. I particularly insist on the curved surface, and every other available means to effect *a thorough surface drainage.* This is all essential to *every* plan of railroad superstructure; and it is only surprising that so little attention has been paid to it. The ramming process should be repeated, whenever experience shall indicate a necessity for it; probably at every fall and spring, will be sufficient.

Should the heads and feet of the piles be found to bruise in driving, (as they certainly would without proper precautions to prevent it,) the former may, according to Major Turnbull, of the United States Topographical Engineers, (see his very valuable report on the Potomac aqueduct,) be obviated by simply dressing off the head of the pile to a concavity of about an inch, and adapting to it a piece of sheet iron; and the latter by nailing on a narrow strip of the same material.

On the score of expense, piles will be found to compare not very unfavorably with other plans of superstructure. To form a good and economical road, the timber should by all means be either Kyanized, or Earle-ized.* Probably, the latter process will be most extensively employed in future, as it is much the cheapest.

I have before asserted, that if the piled superstructure should succeed, (and I certainly see no reason to doubt that it will) it will effect a diminution of the annual expenses, and a consequent increase of annual profits, of at least twenty-five per cent. Before closing this paper, it may not be amiss to consider on what grounds my assertion is based.

In doing this, I will again admonish my professional reader of the

* Doubts have recently arisen with regard to the efficacy of Earle's process for the preservation of timber. These doubts are chiefly founded upon two facts:

I. The wooden pavement in this city, in Sixth street between Chesnut and George, a part of which was prepared by Earle's process prior to being laid, *now exhibits symptoms of decay.*

II. The recent admirable experiments of M. Boucherie, upon the means of preserving timber, show that whilst corrosive sublimate, and pyrolignite of iron, effectually protected vegetable pulps from decay; the sulphates of copper and iron, (employed by Dr. Earle) were so inert as to retard corruption in but a very trifling degree. Com. Pub.

difficulty one labours under in attempting to *average*, and *generalize* in these matters. If my assumptions should appear to some of them to be too low, and to others too high, let them exercise a little charity towards me; for I am fully sensible of the vagueness of deductions drawn from such premises.

Let us then assume the gross annual expenses of maintaining a single track railroad, doing a tolerable business, at $1,000 per mile per annum. One half of this, or $500 per mile per annum, may, in most instances, be assigned to labour, materials and tools, necessary for repairs and adjustments of the track; $300 of it to labour, and $200 to materials and tools.

Now on the supposition that our timber is Kyanized, we may safely count upon reducing the former item to $150, and the latter to $100, which gives an annual saving of expense of $250 per mile, which is twenty-five per cent on our assumed total expenses of $1,000. And if, moreover, we set down the annual expenses at one half the gross annual receipts, which on the average is not very far from the truth, we of course have, instead of an annual profit of $1,000 per mile, one of $1,250, or an increase of twenty-five per cent.

Certainly this is an object worth striving after, and one affecting seriously the success of the railroad system. Whether it can be secured by the adoption of a piled superstructure of Kyanized timber, must be left for experience to determine. I think it can, and I hold moreover to the belief, that the attainment of a *perfect (practical) railroad*, will be found essentially to depend upon the aid of piles.

Improvement of the Ohio River.

We are indebted to the politeness of C. B. Trego, Esq., of the House of Representatives of this state, for a copy of the report "Relative to the navigation of the Ohio River" made to the Senate, by a select committee, of which Mr. Darsie, of Alleghany, was Chairman.

From this document we extract two statistical tables, prepared by Mr. Josiah King, a merchant of Pittsburg, (at the request of the chairman of the select committee,) which are valuable, as furnishing a proximate view of the present export trade of that city, and the existing charges of transportation thence, by the Ohio river, in its present condition.

The report referred to, is designed to attract the attention of the Federal Government, to the importance of scouring away the shoals of the Ohio by *wing-dams*, so as to form a steamboat navigation, having at the lowest stages of the water a minimum depth of four feet from Pittsburg, in this state, to the falls in the river at Louisville, Kentucky, a distance of 609 miles. COM. PUB.

Table showing the amount of tonnage shipped at Pittsburg to ports on the Ohio river, from 15th July to 15th November, inclusive, in the years 1840–'41, at the various rates per 100 lbs. actually paid; the aggregate cost, the average cost per 100 lbs., the cost of the same at 25 cents per 100 lbs., and the excess aggregate sum paid over 25 cents per 100 lbs. Compiled chiefly from shippers' books, by J. King.

TABLE No. 1.

	Quantity of freight shipped at Pittsburg, at the following rates per 100 lbs., from the 15th of July to the 15th of November, 1840 and 1841.										Aggregate lbs. ship'd in 4 low water months 1840 & 1841.
	$1 75	$1 50	$1 25	$1 00	87½ cts.	75 cts.	62½ cts.	50 cts.	40 cts.	25 cts.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	Total lbs.
1840,	240,000	228,000	912,000	2,040,000	144,000	3,876,000	2,946,000	1,290,000	1,146,000	1,332,000	14,154,000
1841,	150,000	1,104,000	1,920,000	3,792,000	696,000	1,944,000	1,260,000	1,506,000	60,000	330,000	12,762,000
Total,	390,000	1,332,000	2,832,000	5,832,000	840,000	5,820,000	4,206,000	2,796,000	1,206,000	1,662,000	26,916,000

	Aggregate lbs. ship'd in 4 low water months, 1840 & 1841.	Aggregate cost of same.	Average cost per 100 lbs.	Aggregate cost computed at 25 cts. per 100 lbs.	Excess of actual cost over 25 cts. per 100 lbs.
	Total lbs.				
1840,	14,154,000	$102,626 50	72½ cts.	$35,385 00	$67,241 00
1841,	12,762,000	118,245 00	92½ "	31,905 00	86,340 00
Total,	26,916,000	$220,871 50		$67,290 00	$153,581 00

There were from 15th July to 15th November, 1841, departures of steamboats from Pittsburg, for ports on the Ohio river, 115.	
Estimated number cabin passengers, at $5 each above average high water rates, 5,750,	$28,750 00
Estimated number steerage passengers, at $2 each above average high water rates, 8,000,	16,000 00
There were, in same time, departures of Keels and Barges, 187, with 2,000 passengers, at $1 extra,	2,000 00
Add to this the extra amount on freights, as above, in 1841,	86,340 00
And we have an excess on the business of the port of Pittsburg alone, in one year, of	$133,090 00

You will observe that the above table contemplates only the business of Pittsburg. I have no data for estimating the business that pertains to the various other ports on the Ohio, but it is in all probability, altogether, four times as much as what is here exhibited. It should be borne in mind also, that if a permanent depth of three feet could be secured on the Ohio river, a vast amount of business would be done that is forced into other more lengthy and hazardous routes. It is now a matter of complaint by the Philadelphia merchants, that they were compelled, during the past summer, to pay 25 to $30,000 freight from Philadelphia to New York, on goods sold to their customers, who, from the low water in the Ohio, were forced to the longer and more expensive route of the Lakes.

Another important consideration in favor of improving the Ohio river is, that not only Pennsylvania, but Maryland, Ohio, and New York, have expended millions in constructing canals and railways with reference to the trade of this river, and almost every state in the Union has a deep interest in it as a link of much moment in their chain of commercial intercourse. There are about 400 steamboats on the western rivers, and at least 100 of those belong properly to the Ohio river trade; more than that number indeed were built and are owned at Pittsburg.

The following table is compiled from the records of the City Wharf Master.

TABLE No. 2.

1841.	Steamboat Arrivals,	Tonnage at Custom-House Measurement,	Keel Boat Departures,	Tonnage computed,	Depth of Channel, at 1st and 15th of month. 1st. Feet, Inches,	15th. Feet, Inches,	Flat—Depart,	Tonnage,
January,	23	3,440	12	260	Ice.	11.0		
February,	28	2,982	11	213	9.6	Ice.		
March,	93	12,235	27	623	4.6	6.0		
April,	94	12,908	48	1,013	15.0	9.4		
May,	86	12,463	49	1,090	12.3	10.0		
June,	66	7,514	50	1,100	4.6	2.5		
July,	34	3,732	49	1,485	4.4	1.11		
August,	8	319	57	2,115	1.9	0.11		
September,	13	1,028	60	2,460	1.3	1.0		
October,	47	3,521	44	1,510	2.10	2.6		
November,	69	8,539	43	1,100	2.10	4.0		
December,	59	8,047	24	530	5.2	11.0		
Total,	620	76,728	474	13,499			1,218	9,206
	653	79,850	Departures S. Boats.					
Total,	1,273	156,578	Arrivals and Departures.					

Note by J. King.—The steamboats arriving up the river from July to October may be said, generally, to carry no cargo. They take very little down, but run chiefly with reference to passengers, and for what freight they do take at stages of water below three feet high, rates say 75 to 150 per c. 100 wt. to Louisville, is charged. Boats of draft and bearings adapted to a thirty inch stage of water are multiplying; and if the river could be so improved as never to have less than thirty inches in channel, individual enterprise would immediately furnish boats in numbers adequate to carry any amount of freight that might offer, (it is confidently believed,) at 25 c. per 100 wt. and thereby if prices of freight be reduced to a proper standard on the Pennsylvania canals, render the Ohio river and Pennsylvania route, the *cheapest*, as it is the shortest and safest between most of the western states and the sea-board. The foregoing table is interesting, not as exhibiting a *large* business done, but as showing that a considerable business found its way via. Pittsburg, to the Ohio river, despite exorbitant rates both on the canals and river, amounting to $3 per 100 wt., from Philadelphia, or Baltimore, to Louisville; and thus demonstrating, that if the expense of the same service can be permanently reduced to $1 or $1½, the route in question would be the favorite route, and all the while filled with goods and produce in transitu between the eastern and western cities. It is the opinion of experienced navigators of the Ohio river, that wooden steamboats can and will be constructed to carry eighty or 100 tons of cargo, on thirty inches of water, and that iron boats can be made to carry 100 to 150, on the same water.

Rules and regulations, proposed to be observed by Enginemen, Guards, Policemen, and others, on all Railways, recommended by the Railway Conference held at Birmingham, England, Jan. 1841.

Orders to Enginemen and Firemen.

I.—No locomotive steam engine, except in case of some extraordinary necessity, shall pass along the wrong line of road—that is to say, on the right hand line as it moves forward—but shall, in all cases, observe the same rule of the way as on the turnpike roads, by proceeding along the left-hand line. And every engineman and fireman shall keep a good look-out all the time the engine is in motion. And no person, except the proper engineman and fireman shall be allowed to ride on any locomotive steam engine or tender without the special license of the Directors, or of the engineer or manager of the railway.

II.—In case of accident, if any engine shall be unavoidably obliged to pass on the wrong line of road, the engineman shall always send his assistant, or some other person, back beyond the nearest stopping place, or shunt, before the engine moves backward, to warn any engine coming in the opposite direction; and if dark, the man who goes back in advance of a returning engine shall take a light, and make a signal, by waving the same UP and DOWN to any coming engine to stop; and the engineman of the engine moving on the wrong line shall make constant use of the steam-whistle, and must not move in the wrong direction further than to the nearest shunt, and being arrived there, shall proceed instantly to remove the engine off the wrong line of road.

III.—All engines traveling in the same direction shall keep half a mile at least apart from each other; that is to say, the engine which follows shall not approach within half a mile of the engine which goes before.

IV.—No engineman shall, at any time or under any circumstances, leave his engine or train, or any part of his train, on the line of way, without placing a man in charge of the same, to cause the proper signals to be made to prevent other engines from running against them.

V.—Enginemen having charge of goods or luggage trains shall always exert themselves to keep out of the way of coach trains, by shunting, if necessary; and, if doubtful of getting out of the way of a coach train, shall direct gatemen and plate-layers to make signal to coach trains that a luggage train is before them.

VI.—No engine, carriage, or wagon, or train of carriages or wagons, whether loaded or unloaded, shall (except only in case of absolute necessity, to prevent accident or collision) stop upon the line of any highway, so as to interrupt the passing along such highway or public road, whether the same be at, or near, to any of the stopping places on the railway or not.

VII.—No engine shall be allowed to propel before it a train of carriages or wagons, but shall in all cases draw the same after it, except when assisting up an inclined plane, or in case of any engine being disabled on the road, when the succeeding engine may propel the train

slowly as far as the next shunt, or turn-out, at which place the said propelling engine shall take the lead.

VIII.—In the event of the road being obscured by steam or smoke, (owing to a burst tube, or from any other cause,) any engine or train coming up shall not immediately pass through the steam or smoke, but the engineman shall stop at a sufficient distance to prevent a collision, and shall ascertain that the way is clear and safe before attempting to proceed.

IX.—If a coach train be stopping to take up or set down passengers, on the road, or for any other cause, luggage trains are not allowed to pass it, while so stopping, on the opposite line; and if the engineman of a *coach train* sees another coach train stopping on the road, he must slacken speed as he approaches it, and blow his whistle, to give notice to passengers belonging to the stopping train, that another train is about to pass them.

X.—In going down any inclined plane, every engineman having charge of a luggage train shall take care that he has full and complete control over the speed of his train, by pinning down, or causing to be pinned down, his wagon breaks, fewer or more, according to the size or weight of the train, whether there be a luggage breaksman with the train or not. And in case of accident for want of this proper control over the speed, the engineman shall be held responsible. And the policemen at the top of the inclines shall, and are hereby charged to, assist in pinning down the breaks, when desired so to do by the engineman of the train.

Rules to be observed during a Fog, or in Thick Weather.

XI.—Whenever a coach train stops at any of the stations or places for taking up or setting down passengers, (during a fog, or in thick weather,) the gateman or policeman of the station shall immediately run 400 yards behind the train, or so far as may be necessary to warn any coming engine, in order to prevent its running against the other; and all enginemen shall slacken speed in foggy weather, and proceed at a slow pace at an ample distance from, and as they approach, each of the stations and stopping places, in order that they may have the complete control of and be able to stop their engines and trains without risk of running against any train which may happen to be waiting at such station or stopping place. And in case any engine (whether with coaches or luggage wagons, or without) shall stop in foggy or thick weather in any part of the road where there shall be no platelayer to render assistance, the fireman shall immediately run back 400 yards, or so far as may be necessary to warn and stop any other engine coming in the same direction.

In foggy weather, enginemen are cautioned to make frequent use of their steam-whistle when they approach any station; also, whenever they are obliged to stop on the road, or when, from any cause, they are obliged to go slower than usual, in order to prevent accidents from trains which may be following on the same line.

Order to Gatemen and Policemen.

XII.—All policemen and gatemen are required, when a luggage train approaches their several stations, and before she comes up, to go on the line and inspect both sides of the train, to ascertain whether any of the loading (particularly bags of cotton or wool) have slipped so as to *overhang* the wagon more than when first loaded; and if such be the case, to make immediate signal for the *train to stop*, in order that the loading may be put right and fastened on again before the train proceeds.

N. B.—All enginemen, firemen, guards, policemen, gatemen and others to whom the foregoing rules may apply, are held responsible for their strict execution and observance; and they shall report to the Directors, or to their immediate superintendent, any servant of the Company who shall refuse or neglect to comply with the regulations hereby ordered to be observed.

Code of Signals recommended to be observed on all Railways.

By Night.—The *white* light, stationary, indicates that all is right, but if waved *up* and *down*, is a signal to stop; if waved *to* and *fro*, sideways, to proceed cautiously.

The *Red* light, stationary, is a signal *always to stop;* if on a moving train it is a caution to all following trains to keep the required distance.

By day.—The *Red* flag, or ball disc, is the signal always to stop.

The *Blue* flag, or ball, is to stop second class coach trains or luggage trains, for the purposes of traffic.

The *Black* flag is used by plate-layers, to indicate that the road is undergoing repair, and that trains must pass slowly.

It is to be understood, that any flag, or hat, or lamp, of whatever colour, waved up or down, is a signal to *stop*.

Regulations as to Signals.—1. Every train on the railway shall shew a red bull's eye, or reflector lamp, on the last carriage or wagon; and the guards of the coach trains, the breaksman of the luggage trains, and the engineman of an empty engine, or, with a wagon train without a breaksman, shall see to, and be held responsible for, the execution of this order; and if a coach, or truck, or horse-box, or wagon, be attached to, or detached from, a train on any part of the road, the guard, or breaksman, or engineman shall immediately change and replace the red bull's eye, or reflector lamp, so that the same may still be in the *rear* of the last carriage or wagon in the train, showing backward.

2.—Every engine tender must carry a lamp, so fixed as to admit of being turned round, exhibiting a *white* light forward, and a *red* light backward, in whichever direction the engine may be moving.

3.—Every gateman or policeman shall light his gate or station lamp at dusk, and shall have his hand lamp constantly trimmed and burning, and ready to give such signals as may be required.

4.—If a coming engine or train be required to stop to take up passengers, a *blue* light must be shewn in the gate-lamp; otherwise the common *white* light.

5.—If a train approaches when a previous train has passed through, only a few minutes before, the gateman shall signify this circumstance to the engineman by the waving of his hand-lamp *to* and *fro*, sideways, which means that caution is required; on which signal all enginemen are required to go slowly and keep a good look out.

6.—But if a gateman, owing to some accident, or any extraordinary cause, wish to stop an engine which is approaching, he must show his *red* light, and must also wave his hand-lamp *up* and *down*, up to the height of his head, and then down to the ground, till the engine comes up; and all enginemen are required to stop at either of these signals being given; and a gateman must make this signal to an approaching engine, if a previous engine has passed through his gate only one or two minutes before.

N. B.—The *red* flag, or ball, must be used in the day, in the same manner as the *red* lamp by night.

Rockets or *blue* lights are extraordinary signals, and when an engineman sees them he must immediately stop to ascertain their cause.

Engine Whistle.—7. When *one long whistle* is given, it is a signal to gate-keepers, policemen, and others in front, that an engine is coming, and this signal is to be used on approaching public roads, during a fog, or when a first class train approaches a station where a second class train is stopping, and generally as a caution when required, for persons on the line to keep out of the way.

But when an engineman wishes to make signal to the guards, or breaksmen, *on the train* that they are to put on their breaks and stop, he must give a *quick succession of whistles*, making an interrupted, tremulous, or vibrating sound; and all guards, or breaksmen, whether with coach or luggage trains, hearing this signal, *must immediately* hold hard on the break, or breaks, under their charge, so as to stop the train *as quickly as possible.*

Locomotive Engines on the English Railways.

It is doubtless known to most of our readers that on the railways of Great Britain, the Locomotive engines in use, may chiefly be separated into two distinct classes.

I. The *four-wheeled* engines, of the pattern manufactured by E. Bury, of Liverpool, and perhaps by others.

II. The *six-wheeled* engines, devised by R. Stephenson, and manufactured by various parties.

The first kind of engine has four wheels, coupled or uncoupled; when used to draw freight its wheels are coupled, but when employed as a passenger engine, the coupling bars (if it has them) are taken off, and but two wheels are then used as drivers.

These engines are commonly allowed only from one half to one inch play at both flanges, and have other peculiarities not necessary to be enumerated for our present purpose.

The second kind of engine has six wheels upon *a stiff frame*—the play allowed to the flanges is from one to two inches—the middle pair of wheels are usually, if not invariably, the drivers, and have no flanges: though we notice in the drawings of engines of this pattern, made by the Messrs. Rennie, and by the Messrs. Hawthorn, that flanges are shown to all the wheels.

There are, we believe, some locomotive engines of other forms used in England,—but they are comparatively few,—and for general purposes we may regard the English locomotives as admitting of the classification adopted.

We believe it has been a prevalent opinion in England that the six-wheeled engines—on account of their stiff frames, great length, and large flange play—were more apt to "fly the track" in consequence of lateral irregularities or curves in the road, than those with only four wheels; yet some serious accidents have occured with the latter, especially one on the London and Brighton railway, in October, 1841, where a four-wheeled engine, attached in front of one with six-wheels, was employed to aid it with a heavy train; and whilst the two machines were advancing with their load, at a pace of nearly thirty miles an hour, they entered an irregular piece of road, when the auxiliary, or four-wheeled engine, which was leading the van, suddenly commenced lurching, and upset from the track, causing the loss of several lives.

The coroner's jury who examined into the circumstances of this case, levied a small deodand upon the locomotives, and pronounced the opinion in their verdict, "that the four-wheeled engines used on this line, are not of a safe construction, and they recommend their discontinuance."

This verdict at once roused public attention to the subject, the condemnation of four-wheeled engines being directly in the face of the experience upon the London and Birmingham railway, where more than *ninety* similar machines of Bury's pattern were in use, and had conveyed some hundreds of thousands of passengers with great speed and perfect safety.

The press immediately engaged in the discussion of the relative merits of four and six-wheeled locomotive engines, and as might have been anticipated, diametrically opposite opinions were advanced—with equal plausibility and force on both sides—without reaching satisfactory conclusions.

Under these circumstances, Mr. Herapath, the editor of the Railway Magazine, undertook a special tour over the most important railways, by actually riding upon the locomotives with the engine drivers; proposing to note carefully the motions and peculiarities of the two species of engines, and collect a mass of practical facts, which would en-

able a sound and safe opinion to be formed upon this question, so important in English railway practice: the results of this tour have been communicated to the Railway Magazine, in a series of articles which we propose to republish for the information of our readers, though we must remark, that the working of the English machines does not have as direct an application to American locomotives as might be imagined, in consequence of the present almost universal use in this country of six-wheeled engines, *with leading and vibrating trucks*, which entirely and most favorably change the running character of the machine, from that inherent to the stiff framed six-wheeled engines employed upon the English railroads; the leading truck piloting the locomotive through curved and irregular portions of the way with a facility and success, which enables them to travel safely upon sinuous roads—even though curved with radii as low as 400 feet—with a speed, that if practicable at all, would certainly not be safe, with the six-wheels fixed upon a stiff frame, as in the English locomotive engines.

M.

From the Railway Magazine.

Facts and Observations on Four and Six-Wheel Engines. By John Herapath, Esq.

North Union.—The Company belonging to this line (from Parkside, on the Liverpool and Manchester railway to Preston, 22½ miles,) work with their engines the Preston and Wyre, nineteen miles, and Lancaster and Preston, twenty-one miles, and yet, strange to say, farm the carriage of their own goods upon their own line. They have twenty-three passenger engines, namely, two six-wheel engines and twenty-one four-wheel. Their six-wheel have outside bearings, and their four-wheel all inside. The six-wheel are about 12½ tons each, having four and a half tons on the front wheels, seven on the driving, and one ton on the hind wheels. Their mode of working these engines is somewhat peculiar. An engine runs one day 174 miles, the next 129, and the third day eighty-four, after which it rests for examination and reparation, if wanted, three days. They have no coupled engines, and their average gross load is about fifty tons, including engine and tender, and all their driving-wheels have flanges. The number of efficient engines is now twenty, which, compared with some other lines, speaks volumes in praise of the care and good management of their locomotive superintendent, Mr. Hunt, whom I found to be not only exceedingly polite and attentive, but a very observing and intelligent young man.

"We have only," says this gentleman, in the official reply to my circular, "had one broken cranked axle, broken in the cheek of the crank, and the engine was not able to proceed after the fracture. The engine—a six-wheel uncoupled engine—having outside bearings, was, I believe, the principal cause of the fracture, which happened in a curve descending sixteen feet a mile." No accident or inconvenience,

save delay, happened in consequence. Nor has any engine run off the rails.

Mr. Hunt speaks in very warm terms of Bury's engines, several of which are on the line.

The play of the wheels upon the rails of this line varies from three-fourths to seven-eighths of an inch. The cost of a four-wheel engine is £1,150; and of a six, £1,250. They find the four-wheel engines more economical in repairs, and burn a trifle less of coke. For instance, two six-wheel in the last year, including, it is said, some rather unusual repairs, cost £ 524; while seventeen four-wheel, for the same period, cost, altogether, £1,836; and the average consumption of coke per mile, by the four-wheel, is 35.42 lbs.; and of the six-wheel, 35.54 lbs. There is a trifling rolling motion in both four and six-wheel engines, when descending or upon curves, but Mr. Hunt thinks the six-wheel rather the steadier of the two. They have no engines which can be called top-heavy. In reply to the question whether they have any practical proof that the distance of the cranks from the longitudinal axis produces any sinuous motion, Mr. H. says, they have in an outside cylinder engine. He adds, from his experience on the Dublin and Kingstown railway, that the longer the connecting rod, and the wider the application of power is, the greater is the effect of sinuous motion. On the Dublin and Kingstown it seems there are outside bearings, and cylinders outside of these.

The total number of miles run per annum by all the engines of this company is 253,596, and the average of each engine, 13,347, the expense per mile of the locomotive power being 1s. 6.7d., including a sum for depreciation, which I could not ascertain exactly, but believe amounts to about the odd pence over the shilling.

Upon two of this company's engines I rode—namely, No. 13, a six-wheel engine, and No. 1, a four-wheel with outside cylinders, and four feet six inches wheels. The motion of the former engine I did not find to be at all different from that of other six-wheel engines; but the outside cylinder engine had some of that wriggling motion I observed in the American engines, but not so much as in Norris's. I must confess, however, notwithstanding I have found the same motions in all three engines I have ridden on having outside cylinders, that I am still unconvinced that it is exclusively due to the outside cylinders; but of this hereafter.

Manchester and Leeds Railway.—Before I say anything of the object of my visit to this line, I must be permitted to render my public acknowledgments for the generous and handsome conduct I have experienced from beginning to end from the Directors, officers, and all parties without exception, belonging to this company with whom I have come in contact. Captain Laws, the manager, has been particularly anxious to afford me every opportunity and facility for prosecuting my inquiries, and to him and Mr. Fenton, the superintendent of the locomotives, I am indebted for much valuable information.

I have indeed had the good fortune on this line to have made such observations, and to have such facts brought before me, as to enable

me to decide on one or two points, on which, before, I had great difficulty in making up my mind, and I therefore consider myself peculiarly fortunate in my intercourse with the Manchester and Leeds railway.

The length of the line worked by this company is sixty miles from Manchester to Leeds, but the portion constructed by them is only fifty-one miles, that is, from Manchester to Normantown, the junction with the North Midland railway. The company's stock of engines is thirty-eight, that is thirty-six six-wheel with outside bearings, and two four-wheel with inside bearings. Of these thirty-three are now in an efficient state. The six-wheel engines weigh in working trim about seventeen tons; the four-wheel thirteen tons, twelve cwt.; the weight on the front wheels of the six-wheel engines is six tons, on the driving eight and a half, and on the hind wheels two and a half. On the driving-wheels of the four-wheel engines the weight is about eight and a half tons.

Of the six-wheel engines eighteen have coupled wheels, and both the four-wheels are coupled.

Many of the driving wheels of the six-wheel—indeed, nearly all that I have seen—are without flanges, but others have them. The average gross load is 104 tons.

Owing to the heavy gradients on this line, particularly from Manchester to the summit, the engines are necessarily weighty. Of fourteen engines which began running July, 1839, only one crank axle, however, has broken; and of eighteen which began February, 1841, only two crank axles have broken; one from a flaw in the iron, and the other not. One was a coupled engine, and the other two uncoupled. They were unable to proceed with their trains, but no injury happened to any passenger in consequence. Notwithstanding, there are some sharp curves in this line, for instance, three respectively of fifteen, twenty, and thirty chains radius, and that the average speed is high, no engine has at any time run off the rails. The average pressure worked with is fifty-five lbs. to the square inch, the cost of the engines £1,500, the consumption of coke thirty-seven lbs. per mile, number of miles run per year by all the engines 594,000, expense of repairs 2s. 6d. per mile run.

The engines of this company generally run 120 miles each day, (changing, however, their times, so as to equalise the work of each) for five days successively, and then resting two days for examination and repairs. Each engine carries a sand-box to obviate the greasiness of the rails, which their heavy loads, and the almost everlasting dampness of the Manchester atmosphere render quite necessary.

The returns to me on this line are far more full than I have yet received from any other company. It appears that there are 147 men and boys, with wages varying from £2 6s. 8d. to boys 7s. 4d. per week, employed in the locomotive department only, making an average of £1 8s. 11d. per week; that the cost of coke for six months, ending August 31st last, was £3,786 7s. 6d., the wages on repairs done £977 1s. 10d., the cost of repairs not done by the company £1,643 1s. 5d.; the average speed in miles per hour actually performed by passen-

ger trains is twenty, the number of stoppages, exclusive of termini, being equal to 11½ miles per trip; the average weight of passenger trains, exclusive of engine and tender, fifty tons; and of goods trains, with the same exclusion, 104 tons; the average coke consumed per mile traveled, with passenger trains, is 35.52 lbs.; with goods, 48.02 lbs.; the average cost of repairs per mile traveled by the engines, is 2.62d.; cost of coke per mile, 3.09d.; cost of other charges, not included in repairs, 4.92d. per mile; and the total cost per mile of the passenger trains 10.12d. and of luggage 11.94d.; the weekly miles run for passenger trains are 7,140, for goods 2,732, and pilot engines 993. The length of the line is sixty miles, number of stations when the 147 men are employed is seven.

Mr. Fenton assured me that no engine comes in from the maker without undergoing most extensive alterations. The system of working expansively, and discharging the steam before the end of the stroke, it seems, has found its way long since into this establishment, together with other improvements in the chimney, fire-box, &c., which I shall hereafter notice, by which great savings accrue to the company in the working of the line. Captain Laws, indeed, in the general management, appears to be well seconded by the ability and untiring zeal of Mr. Fenton, in the locomotive department.

I have already alluded to the kind attentions I have received from the officers of this company—one, not among the least gratifying to me, was the putting on of a four-wheel engine, the "Clarence," with the coupling rod off, to take a train of goods as far as Rochdale, 10½ miles, and return with another load, that I might satisfy myself of any peculiarities of its action up and down steep gradients as a four-wheel engine. This was one of Bury's engines, and a play of 1.2 inch upon the rails. When in high speed she had a good deal of sinuous motion, but was free from pitching or rolling. At starting I observed her lift in front, so as to give me some alarm. This I found was occasioned by the road being sanded, which gave the wheels a good bite on the rails, the coupling link being some six inches above the axles of the wheels, and the steam being let on too rapidly.

While standing Friday morning, November 26th, on the platform with Mr. Gill, Captain Laws, and Mr. Fenton, an engine, the "Dewsbury," a six-wheel-engine, came in with a load which she had brought all the way from Todmorden, a distance of nineteen miles, wholly disabled in the left cylinder, and having drawn her load with the right only. A part of the road was up hill, but the greater portion down hill. When she came in I observed the left leading wheel much cut in the flange, and pointed it out to Captain Laws as an effect of the sharp curves on the line, which he, however, would not admit. Reflecting upon this, and after the engine had backed about 200 yards, a thought struck me that it might be owing to the action of one cylinder. I consequently hastened to her, and found that she had also her left trailing wheel flange a trifle cut (her driving wheels having no flanges,) but neither of the wheel flanges on the right side of her, it was evident, had approached the rails at all, or gone near them. With these facts I was much pleased, as affording practically conclusive evi-

dence on a disputed point, to which, in my report, I shall probably recur.

By some accident, I had not the good fortune to meet with Mr. Gooch, the company's engineer, who I understand is a very talented and well informed man.

The improvements which I have alluded to in the locomotives in this establishment are—

1st—An improvement in the chimney. As the makers deliver the engine it is cylindrical, fourteen inches diameter. The improvement consists in turning into the frustum of a cone, the upper part being thirteen inches diameter and the lower only ten. By this contrivance alone Mr. Fenton informed me that four cwt. of coke was saved on thirty-seven cwt. in a run of 120 miles, the blast pipe being opened from three to three and three-fourth inches in diameter.

2ndly—Various trials having convinced him that about sixteen inches was the best depth for the fuel of the fire when the bars were horizontal, but that in all cases of horizontal bars the coke near the door was in a less intense combustion than near the tube plate, he gave the bars an inclination of one in ten descending towards the tube plate, and placed the level of the bars near the door of the fire-box, 13½ inches below the lowest tube, which made the inner part of the bars 17½ inches below the said lowest tube, the fire-box being forty inches in length.

3rdly—For the purpose of taking away the damper from the chimney, he made the ash-box nearly air-tight all round except in front. By this means he stopped the further combustion of the coke, and lowered his steam at pleasure.

By the means of these improvements, and cutting off at five-sixths of the stroke and suffering the steam to escape, he successively improved the engines as they come from the maker. The following two are examples:—

Name.	As from Maker.	Improved July.	Further improved, Aug.	Do. do. Sep.
"Mersey,"	59.05lbs.	not running	32.27	27.27
"Irk,"	52.88	25.45	25.65	24.80

Upon the four-wheel engines of this company the weight on the driving wheels in a working trim is seven tons twelve cwt.; on the leading wheels six tons, cost £1,450; cost of the six-wheel engines, about £100 each more.

This company possess upon the whole an excellent stock of powerful engines, kept in a most efficient state of repair, and those on which I have rode are inferior in steadiness of motion to none that I have met with. I believe they reckon the engines of Sharp, Roberts, & Co. among their best.

Grand Junction.—I forgot in my account of the Grand Junction to mention that their gross average load is about fifty-eight tons; that some of their engines have only five feet driving wheels, though most are five feet six inches; that each engine runs about 195 miles the day of its work; that they have one four-wheel engine (which I understand is a pattern engine for the Paris and Rouen railway) built with

outside cylinders, and I believe five feet driving-wheels; and that the number of miles run daily by the engines, is 1588, including nineteen extra miles each journey between Manchester and Warrington.

I was exceedingly desirous of riding on the new four-wheel outside cylinder engine, for the purpose of seeing whether this engine had the same shuffling, wriggling motion that three others of the kind had on which I had rode. So anxious was I on this account that one very cold day I went without my breakfast to keep an appointment made with me to put the engine on, but was for some reason disappointed; the engine, which I believe was not at all on the list to go out, having been put on at a very different hour.

[TO BE CONTINUED.]

Practical and Theoretical Mechanics and Chemistry.

Analysis of Well-water, Philadelphia. By Jas. C. Booth and M. H. Boye.

Induced to undertake the examination of this water by Mr. Samuel Webb, of Philadelphia, we deemed it a matter of sufficient interest to extend our investigations farther than required, in order to ascertain with precision all its constituents, and therefore, we think that it may not be uninteresting to some of the readers of the Journal.

The well is in the yard of 158 West Callowhill street, and was made by first digging about twenty feet through the common superficial clays, and then several feet into the Gneiss rock in a partially decomposed state. Although water was obtained in the clay, it was yielded much more abundantly after penetrating the rock, so that the water from the latter is the prevailing character of the fluid in question.

A sediment sometimes appears in it, but at the time we obtained it, it was said to be unusually clear. It was this clear water which we subjected to analysis. It exhibits a slight acid reaction, and deposites by standing at first a red flocculent precipitate of hydrated peroxide of iron, and subsequently coats the vessel containing it with an adherent layer of an ochrey color, consisting chiefly of the above oxide of iron with the carbonates of lime and magnesia. The same sediment was obtained more abundantly by evaporating the water into a small bulk and subsequent filtration. The sediment and the concentrated liquid evaporated to dryness, were separately investigated.

The deposite consists in 100 parts of:

Silica,	27.75
Peroxide of Iron,	4.83
Carbonate of Lime,	45.15
" Magnesia,	22.27
	100.00

The concentrated liquid, evaporated to dryness, gave a residue of the following composition:

Silica, - - - - - -	10.91
Peroxide of Iron, - -	a trace
Carbonate of Lime, - - -	4.09
" Magnesia, - -	3.40
" Soda, - - -	34.65
Chloride of Sodium, - - -	44.74
" Potassium, - -	2.21
	100.00

The whole amount of solid matter in one gallon of the water was 6.22 grains, of which about eight-fifteenths, or a little more than one half, was deposited during evaporation. In this should be included a small amount of sulphuric acid, and a mere trace of organic matter which were neglected in the analysis.

Observations on Mosaic Work and Cameo-cutting. *By* Ch. H. Wilson, Esq., *Architect, Edinburgh.*

The art of mosaic work has been known in Rome since the days of the republic. The severe rulers of that period forbade the introduction of foreign marbles, and the republican mosaics are all in black and white. Under the empire the art was greatly improved, and not merely by the introduction of marbles of various colours, but by the invention of artificial stones, termed by the Italians *smalti*, which can be made of every variety of tint.

This art was never entirely lost. On the introduction of pictures into Christian temples, they were first made of mosaic; remaining specimens of these are rude, but profoundly interesting in a historical point of view. When art was restored in Italy, mosaic also was improved, but it attained its greatest perfection in the last and present century. Roman mosaic, as now practised, may be described as being the production of pictures by connecting together numerous minute pieces of coloured marble or artificial stones; these are attached to a ground of copper by means of a strong cement of gum mastic, and other materials, and are afterwards ground and polished as a stone would be to a perfectly level surface; by this art not only are ornaments made on a small scale, but pictures of the largest size are copied. In former times the largest cupolas of churches, and not unfrequently the entire walls, were encrusted with mosaic. The most remarkable modern works are the copies which have been executed of some of the most important works of the great masters for the altars in St. Peter's. These are in every respect perfect imitations of the originals; and when the originals, in spite of every care, must change and perish, these mosaics will still convey to distant ages a perfect idea of the triumphs of art achieved in the fifteenth century. The government

manufactory in Rome occupies the apartments in the Vatican which were used as offices of the Inquisition. No copies are now made, but cases of *smalti* are shewn, containing, it is said, 18,000 different tints. Twenty years were employed in making one of the copies I have mentioned. The pieces of mosaic vary in size from an eighth to a sixteenth of an inch, and eleven men were employed for that time on each picture.

A great improvement was introduced into the art in 1775 by the Signor Raffaelli, who thought of preparing the *smalti* in what may be termed fine threads. The pastes or *smalti* are manufactured at Venice in the shape of crayons, or like sticks of sealing-wax, and are afterwards drawn out by the workman at a blow-pipe into the thickness he requires, often almost to a hair, and now seldom thicker than the finest grass stalk. For tables and large articles, of course, the pieces are thicker; but the beauty of the workmanship, the soft gradation of the tints, and the cost, depend upon the minuteness of the pieces, and the skill displayed by the artist. A ruin, a group of flowers or figures, will employ a good artist about two months when only two inches square, and a specimen of such a description costs from L.5 to L.20, according to the execution; a landscape, six inches by four, would require eighteen months, and would cost from forty to fifty pounds. This will strike you as no adequate remuneration for the time bestowed. The finest ornaments for a lady, consisting of necklace, ear-rings, and brooch, cost L.40. For a picture of Paestum, eight feet long, and twenty inches broad, on which four men were occupied for three years, L.1000 Sterling was asked.

The Mosaic Work of Florence,

I shall now notice before touching on cameo-cutting. It differs entirely from Roman mosaic, being composed of stones inserted in comparatively large masses; it is called work in *pietra dura.* The stones used are all, more or less, of a rare and precious nature. In old specimens the most beautiful works are those in which the designs are of an arabesque character. The most remarkable specimen of this description of pietra dura is an octagonal table in the *Gabinetto di Baroccio,* in the Florence Gallery. It is valued at £20,000 Sterling, and was commenced in 1623 by Jacopo Datelli, from designs by Ligozzi. Twenty-two artists worked upon it without interruption till it was terminated in the year 1649. Attempts at landscapes, and the imitation of natural objects, were usually failures in former times,—mere works of labour, which did not attain their object; but of late works have been produced in this art, in which are represented groups of flowers and fruit, vases, musical instruments, and other compatible objects, with a truth and beauty which excite the utmost admiration and surprise. These pictures in stone are, however, enormously expensive, and can only be seen in the palaces of the great. Two tables in the Palazzo Pitti are valued at £7000, and this price is by no means excessive. These are of modern design, on a ground of porphyry, and ten men were employed for four years on one of them, and a spot is pointed out, not more than three inches square, on which a man had

worked for ten months. But Florentine mosaic, like that of Rome, is not merely used for cabinet tables or other ornamental articles; the walls of the spacious chapel which is used as the burial-place of the reigning family at Florence are lined with pietra dura, realizing the gem-encrusted halls of the Arabian tales. Roman mosaic, as we have seen, is of great value as an ally to art; but Florentine mosaic can have no such pretensions, and time and money might be better bestowed.

An imitation of the pietra dura is now made to a great extent in Derbyshire, where the Duke of Devonshire's black marble, said to be quite equal to the famous Nero Antico, is inlaid with malachite, Derbyshire spars, and other stones; but the inlaying is only by veneers, and not done in the solid as at Florence. This, with the softness of the materials, makes the Derbyshire work much cheaper, and yet for a table, twenty to twenty-four inches in diameter, thirty guineas is asked. Were a little more taste in design and skill in execution shewn, the Derbyshire work might deserve to be more valued, as the materials, especially the black marble, are beautiful.

I shall now return to cameo-cutting. The art of cameo-cutting is of great antiquity, and is pursued with most success in Rome, where there are several very eminent artists now living. Cameos are of two descriptions, those cut in stone, or *pietra dura*, and those cut in shell. Of the first, the value depends on the stone, as well as in the excellence of the work. The stones most prized now are the oriental onyx and the sardonyx, the former black and white in parallel layers, the latter carnelian, brown and white; and when stones of four or five layers of distinct shades or colours can be procured, the value is proportionably raised, provided always that the layers be so thin as to be manageable in cutting the cameo so as to make the various parts harmonize. For example, in a head of Minerva, if well wrought out of a stone of four shades, the ground should be dark grey, the face light, the bust and helmet black, and the crest over the helmet brownish or grey. Next to such varieties of shades and layers, those stones are valuable in which two layers occur of black and white of regular breadth. Except on such oriental stones no good artist will now bestow his time; but, till the beginning of this century, less attention was bestowed on materials, so that beautiful middle-age and modern cameos may be found on German agates, whose colours are generally only two shades of grey, or a cream and a milk-white, and these not unfrequently cloudy. The best artist in Rome in *pietra dura* is the Signor Girometti, who has executed eight cameos of various sizes, from one and a half to three and a half inches in diameter, on picked stones of several layers, the subjects being from the antique. These form a set of specimens, for which he asks £3000 Sterling. A single cameo of good brooch size, and of two colours, costs £22. Portraits in stone by those excellent artists Diez and Saulini may be had for £10. These cameos are all wrought by a lathe with pointed instruments of steel, and by means of diamond dust.

Shell cameos are cut from large shells found on the African and Brazilian coasts, and generally shew only two layers, the ground being either a pale coffee-colour or a deep reddish-orange; the latter is most

prized. The subject is cut with little steel chisels out of the white portion of the shell. A fine shell is worth a guinea in Rome. Copies from the antique, original designs, and portraits, are executed in the most exquisite style of finish, and perfect in contour and taste, and it may be said that the Roman artists have attained perfection in this beautiful art. Good shell cameos may be had at from £1 to £5 for heads, £3 to £4 for the finest large brooches, a comb costs £10, and a complete set of necklace, ear-rings, and brooch, cost £21. A portrait can be executed for £4 or £5, according to workmanship.

Ed. New Philos. Jour.

On the Application of Water to Anthracite.

All persons who have been much accustomed to the use of anthracite for fuel seem to entertain an idea that the application of water has a beneficial effect. It is the invariable custom of the old inhabitants of the districts where no other fuel is used, to wet the coal before putting it on the fire. A wet paste of small culm, mixed with clay, makes a more lively and pleasant fire than small coal alone. This must arise from the clay retaining a portion of the water until decomposed by the ignited carbon of the coal producing the gases, carbonic oxide and carburetted hydrogen. It has been suggested that the application of vapour of water to anthracite fires in steam-boilers would supply the gaseous or volatile properties of bituminous coal; there is, however, much difficulty in the perfect development of the principle, arising from the compact structure of the coal, and the close manner in which the pieces of coal seem to adjust themselves in the fire. It is necessary that the coal be kept in an active state of combustion while the vapour is passing through, but so little passage being allowed through the fire, when the vapour of water is applied, it shuts off the supply of air, consequently the combustion is diminished. It requires both a very high temperature and a large quantity of pure air, with a full *quantum* of oxygen, to consume carburetted hydrogen—the most important of the two gases. Carbonic oxide burns at a very low temperature, and produces little heat. A quantity of flame may easily be produced by steam passing through an anthracite fire, but it is chiefly that of the latter gas, the former being volatilized without burning, and its powerful effect, consequently, lost. Besides the air necessary to keep up the combustion of the coal in the fire a large quantity is necessary to consume the gases, and that, too, at a high temperature. It appears impossible to attain these results with a common draught.

The writer, after considerable experience, is decidedly of opinion that anthracite cannot be used with advantage in ordinary boilers without a blast. When a blast is used, although it may be difficult, yet it is not impossible to devise a method of producing the full effect from the application of water to an anthracite fire; it is a subject of vast importance, and well worthy the attention of young mechanics and engineers—a fine field for the exercise of their ingenuity. It is quite certain that some anthracite contains ninety-five per cent. of pure carbon, and were it possible to render the entire effect of this

available, certain portions of it converted into volatile inflammable matter by its union with the elements of water, and steadily and continuously applied to the tube or flues of a boiler without loss, anthracite might be considered as a species of concentrated fuel—an invention of incalculable value for steamers going upon long voyages. When anthracite is used for blacksmith work, there is abundance of heat, but a large quantity of cinder is formed; this cinder has generally been considered as a mere oxide of iron, but it certainly contains carbon. It is the same cinder which is produced in large quantities in the refining process of iron works. Possibly oxygen and carbon, in the proportions to form carbonic oxide, are combined with the iron. A minute quantity of water running into a blacksmith's fire, when using anthracite, would remedy this—the presence of hydrogen preventing, in a great measure, the formation of the cinder. It is an axiom in the north of England, that a good gas coal is a good smith's coal, and *vice versâ*. It will be quite impossible to manufacture malleable or bar-iron of good quality, using anthracite for fuel, without the application of the vapour of water. This is a subject of the deepest interest to parties embarking in iron-works, where anthracite must be used for fuel. A patent for producing gas, by passing steam through a retort charged with anthracite, has been taken out by E. O. Manby, Esq., C. E., of Swansea—a gentleman possessing a thorough local knowledge of the anthracite district of South Wales, and who has had the best opportunities of judging of the powers and capabilities of the coal. He produces gas of great illuminating power rapidly and abundantly, which requires no purification. It seems likely that the distinguishing feature in the difference of the several varieties of coal depends upon the presence of the elements of water, either entire or in varying proportions, that are combined with the carbon—anthracite being quite free from them. It is a fair speculation to imagine that the anthracite veins of coal at some period possessed bituminous properties, but that being more immediately acted upon by volcanic commotion, all volatile matter was expelled, while extraordinary pressure being applied left the coal a solid compressed mass of carbon, constituting the peculiar characteristic of anthracite. Mining Jour.

Physical Science.

Electrotype.

The Bavarian sculptor, Stigelmayer, has brought to great perfection the galvano-plastic process. In the space of two or three hours colossal statues in plaster are covered with a coat of copper, which takes with the greatest accuracy the most minute and delicate touches, giving the whole the appearance and solidity of the finest casts in bronze. M. Stigelmayer has also applied his process to the smallest objects, as flowers, plants, and even insects, bringing them out with such accuracy, that they seem to have been executed by the hands of the most skilful artists.—*Letter from Munich.*

Mech. Mag., Sept., 1841.

Meteorological Journal for 1841, *kept at the Lancaster Conservatory of Arts & Sciences, Lancaster, Pa., by* WASHINGTON L. ATLEE, M. D., *Obs.*

1841.	Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet. dew pt. & ther m.	Hygr'm'tr, 2 P.M. Wet bulb.	Sky.	Sky. 7 A.M. D's	Sky. 2 P.M. D's	Sky. 9 P.M. D's	Rain. Rain gauge In's.
January. Average	29.51	29.45	29.56				26.05	35.33	31.92	23.69	29.87	25.53	9.88	32.63	Ent. clr	3	1	10	
Maximum	30.14	30.15	30.10				46.50	55.00	50.00	36.00	45.50	55.00	47.21	55.00	Ent.cld	17	19	16	
Minimum	28.92	28.91	28.78				-7.00	7.50	-1.00	-7.00	3.75	-29.71	0.00	7.50	Prt. clr.	11	10	4	
Range	1.22	1.24	1.32				53.50	47.50	51.00	43.00	41.75	84.71	47.21	47.50					
Omitted		1	1					1	1		1	1	1	1			1	1	6.430
February. Average	29.32	29.29	29.32				25.04	36.39	27.16	22.43	29.38	22.51	13.86	32.14					
Maximum	29.73	29.67	29.64				40.00	54.00	41.00	36.00	42.75	37.36	28.97	45.00	Ent. clr	8	5	18	
Minimum	28.79	28.86	28.89				3.00	13.00	4.00	2.00	7.50	1.82	0.00	12.00	Ent.cld	9	7	6	
Range	.94	.81	.75				37.00	41.00	37.00	34.00	35.25	35.54	28.97	33.00	Prt. clr.	11	16	4	
Omitted																			1.150
March. Average	29.47	29.41	29.41				35.10	49.16	38.63	32.05	41.60	31.00	18.20	41.85					
Maximum	29.84	29.79	29.74				56.50	73.00	61.00	53.00	64.00	63.51	38.15	67.00	Ent. clr	7	7	11	
Minimum	28.75	28.83	28.59				18.50	28.00	25.00	18.50	26.50	1.15	0.00	25.50	Ent.cld	13	12	14	
Range	1.09	.96	1.15				38.00	45.00	36.00	24.50	37.50	64.66	38.15	41.50	Prt. clr.	11	12	6	
Omitted																			4.057

1841.	Winds.	Winds. 7 A.M. D's	Winds. 2 P.M. D's	Winds. 9 P.M. D's	Clouds. 7 A.M. D's	Clouds. 2 P.M. D's	Clouds. 9 P.M. D's
January.	N.	2	1	2	1	0	0
	N. W.	6	5	8	2	0	1
	N. E.	8	8	7	0	0	0
	S.	0	3	1	0	0	0
	S. W.	6	5	5	2	1	2
	S. E.	2	1	3	0	0	0
	W.	4	5	4	3	8	1
	E.	3	2	0	0	0	0
Omitted			1	1	20	21	17
February.	N.	0	4	1	0	0	0
	N. W.	5	7	10	2	7	1
	N. E.	7	4	3	0	0	0
	S.	1	0	2	0	0	0
	S. W.	12	6	5	1	1	1
	S. E.	0	0	3	0	0	0
	W.	3	6	4	8	7	2
	E.	0	1	0	0	0	0
Omitted					10	8	6
March.	N.	4	3	5	2	0	0
	N. W.	2	4	4	4	2	2
	N. E.	7	6	7	1	1	0
	S.	3	2	3	0	0	0
	S. W.	5	5	1	0	3	0
	S. E.	2	1	4	1	0	0
	W.	6	7	3	7	9	3
	E.	2	3	4	0	0	0
Omitted					9	9	15

Meteorological Journal – Continued.

1841.		Barometer.			Attached Thermometer.			External Thermometer.					Hygr'm'tr, 2 P.M.			Sky.				Winds.				Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Dew Point.	Diff. bet. dew pt. & therm	Wet bulb.		7 A.M D's	2 P.M D's	9 P.M D's		7 A.M D's	2 P.M D's	9 P.M D's	7 A.M D's	2 P.M D's	9 P.M D's	Rain gauge. In's.
April.	Average	29.43	29.45	29.41	46.70	55.48	48.88	46.00	55.29	46.22	40.55	47.53	44.83	10.69	49.94					N.	1	1	3	0	2	0	
																				N.W.	7	7	8	6	7	2	
	Maximum	29.94	29.92	29.91				61.00	70.00	60.50	55.00	62.00	63.08	32.04	65.00	Ent. clr	5	2	8	N.E.	9	3	3	1	2	0	
																				S.	2	2	3	0	2	0	
	Minimum	28.53	28.57	28.63				31.50	37.00	32.00	29.00	33.75	23.09	0.00	37.00	Ent.cld	16	10	12	S.W.	4	5	3	4	1	0	
																				S.E.	4	4	8	0	2	0	
	Range	1.41	1.35	1.28				29.50	33.00	28.50	26.00	28.25	39.99	32.04	28.00	Prt. clr.	9	16	10	W.	1	3	1	6	5	3	
																				E.	2	3	1	0	1	0	
Omitted			2						2			2	3	3	3			2				2		9	6	17	3.956
May.	Average	29.41	29.40	29.42	55.40	67.16	59.52	54.87	67.87	56.59	49.21	58.53	50.21	17.68	58.08					N.	4	2	2	1	0	1	
																				N.W.	7	14	9	10	15	4	
	Maximum	29.66	29.64	29.60				71.00	84.50	73.00	66.50	75.25	68.56	31.69	73.00	Ent. clr	8	2	8	N.E.	4	3	5	1	1	0	
																				S.	1	3	3	0	0	0	
	Minimum	28.94	28.96	28.89				34.00	47.00	37.00	30.00	40.00	33.23	0.00	43.00	Ent.cld	10	5	7	S.W.	8	5	5	3	8	1	
																				S.E.	5	3	6	0	2	1	
	Range	.72	.68	.71				37.00	37.50	36.00	36.50	35.25	35.33	31.69	30.00	Prt. clr.	13	24	16	W.	2	1	1	4	5	0	
																				E.	0	0	0	1	2	0	
Omitted																								4		17	2.360
June.	Average	29.46	29.45	29.44	69 27	80.30	74.13	67.78	80.80	70.92	64.62	72.54	68.00	17.82	68.90					N.	5	2	1	0	3	0	
																				N.W.	3	3	7	2	3	2	
	Maximum	29.60	29.65	29.63				77.00	92.00	80.00	73.00	81.50	73.51	32.37	76.00	Ent. clr	12	8	10	N.E.	3	3	3	2	0	0	
																				S.	5	6	5	1	1	0	
	Minimum	29.27	29.25	29.21				57.00	63.00	58.00	54.00	62.50	50.76	0.00	62.00	Ent.cld	12	5	7	S.W.	5	5	9	4	5	3	
																				S.E.	6	2	6	1	2	0	
	Range	.33	.40	.42				20.00	29.00	22.00	19.00	19.00	22.75	32.37	14.00	Prt. clr.	6	17	13	W.	3	8	1	2	7	1	
																				E.	0	1	0	0	0	0	
Omitted																								6	3	15	3.755

1841.		Barometer.			Attached Thermometer.			External Thermometer.					Hygr'm'tr, 2 P.M.			Sky.				Winds.				Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Dew point.	Diff bet dew point and therm	Wet bulb.		7 A.M. D's	2 P.M. D's	9 P.M. D's		7 A.M. D's	2 P.M. D's	9 P.M. D's	7 A.M. D's	2 P.M. D's	9 P.M. D's	Rain gauge In's.
July.	Average	29.54	29.53	29.52	69.29	82.55	72.18	68.74	82.26	70.37	65.61	73.94	59.59	21.44	68.19					N.	4	1	4	1	3	0	
																				N.W.	7	9	6	7	6	0	
	Maximum	29.85	29.81	29.82				80.00	92.50	80.00	78.00	83.75	74.17	27.47	78.00	Ent. clr	18	2	14	N.E.	4	3	2	1	2	0	
																				S.	3	5	2	0	1	0	
	Minimum	29.27	29.27	29.33				60.00	70.00	61.50	55.00	66.00	45.58	0.00	59.00	Ent.cld	4	2	4	S.W.	11	7	9	3	2	0	
																				S.E.	1	0	5	0	1	0	
	Range	.58	.54	.49				20.00	22.50	18.50	23.00	17.75	28.59	27.47	19.00	Prt. clr.	15	27	18	W.	1	5	3	8	14	2	
																				E.	0	1	0	0	0	0	
Omitted.																								2	1	15	1.430
August.	Average	29.61	29.61	29.60	68.50	79.68	72.87	66.10	79.97	69.27	64.08	71.88	62.96	17.00	68.65					N.	1	3	2	0	2	1	
																				N.W.	3	4	2	0	2	1	
	Maximum	29.85	29.84	29.85				75.00	89.00	77.50	72.50	79.25	72.93	26.53	75.00	Ent. clr	5	2	10	N.E.	4	5	5	2	3	6	
																				S.	4	8	5	0	3	0	
	Minimum	29.47	29.46	29.45				58.00	68.00	62.50	57.00	62.50	53.48	5.72	62.00	Ent.cld	8	4	7	S.W.	7	3	5	8	4	0	
																				S.E.	8	3	8	0	3	0	
	Range	.38	.38	.40				17.00	21.00	15.00	15.50	16.75	19.45	20.81	13.00	Prt. clr.	18	24	13	W.	0	2	2	9	8	3	
																				E.	4	2	2	2	5	1	
Omitted			1	1					1	1		1	1	1	1			1	1			1	0	6	4	15	3.835
September.	Average	29.52	29.51	29.52	64.23	74.29	67.35	61.48	74.84	63.78	59.93	67.38	62.48	12.36	66.72					N.	3	2	3	0	1	0	
																				N.W.	6	6	5	1	1	2	
	Maximum	29.80	29.79	29.80				71.50	88.00	77.50	71.50	78.25	73.50	21.85	74.00	Ent. clr	11	4	15	N.E.	4	3	7	0	2	0	
																				S.	2	6	3	0	4	0	
	Minimum	29.14	29.16	29.22				49.00	58.50	50.00	48.00	56.75	48.89	0.00	55.00	Ent.cld	11	8	7	S.W.	5	3	2	2	4	3	
																				S.E.	5	4	6	1	1	0	
	Range	.66	.63	.58				22.50	29.50	27.50	23.50	21.50	24.61	21.85	19.00	Prt. clr.	8	17	8	W.	1	3	1	7	7	0	
																				E.	4	2	3	0	4	0	
Omitted			1						1			1	1	1	1			1				1	0	8	3	10	2.200

Meteorological Journal—Continued.

1841.		Barometer.			Attached Thermometer.			External Thermometer.					Hygr'm'tr, 2 P.M.			Sky.				Winds.				Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 P.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Dew point.	Diff. bet. dew point and therm.	Wet bulb.		7 A.M. D's	2 P.M. D's	9 P.M. D's		7 A.M. D's	2 P.M. D's	9 P.M. D's	7 A.M. D's	2 P.M. D's	9 P.M. D's	Rain gauge In's.
October.	Average	29.53	29.51	29.51	45.31	55,70	48.75	42.40	56.12	45.25	40.69	48.32	43.30	11.98	50.38					N.	6	4	7	0	4	0	
																				N. W.	7	12	8	5	9	0	
	Maximum	29.88	29.90	29.90				58.00	66.00	58.00	56.50	60.25	64.00	24.63	64.00	Ent. clr	18	4	14	N. E.	3	2	2	1	1	0	
																				S.	2	4	3	0	0	0	
	Minimum	28,93	28.96	28.97				30,00	41,50	30.50	27.00	35.75	25.76	0,00	36.00	Ent.cld	5	6	6	S. W.	9	6	7	3	2	0	
																				S. E.	0	0	0	6	0	0	
	Range	,95	.94	,93				28.00	24.50	27,50	29.50	24.50	38,24	24.63	28,00	Prt. clr.	13	20	10	W.	3	1	3	6	8	2	
																				E.	1	1	0	0	0	0	
Omitted			1	1					1	1		1	1	1	1			1	1			1	1	3	3	15	1,835
November.	Average	29,44	29.40	29.42	40.73	46,93	42.20	38.15	46.59	39.48	35.35	40.78	37.26	9,29	42.76					N.	5	3	2	1	3	0	
																				N. W.	5	10	7	7	5	1	
	Maximum	29.96	29.90	29.91				59.50	72,00	62.00	55.50	63.75	67.52	27.55	69.00	Ent. clr	4	1	10	N. E.	5	4	6	0	0	0	
																				S.	2	4	3	0	1	0	
	Minimum	28.97	28,90	29.01				17.00	30.00	21.00	16.00	25.75	16.62	0.00	27.00	Ent.cld	14	9	10	S. W.	8	6	5	3	3	1	
																				S. E.	1	0	2	0	0	0	
	Range	.99	1.00	,90				42.50	42.00	41.00	39.50	38.00	50.90	27.55	42.00	Prt. clr.	12	19	10	W.	4	1	4	3	6	1	
																				E.	0	1	1	0	0	0	
Omitted			1						1			1	1	1	1			1				1		12	11	17	3,127
December.	Average	29.44	29,41	29.42	33,42	39,42	36,82	29.73	39.10	33.74	28.12	33.65	31.20	7.96	36.47					N.	3	2	4	0	1	1	
																				N. W.	4	8	7	2	6	2	
	Maximum	30,03	30.06	30.07				46.50	54.00	53.00	50.50	47.50	51.00	27,36	51,50	Ent. clr	10	4	7	N. E.	3	4	6	0	0	0	
																				S.	2	2	3	0	0	0	
	Minimum	28.80	28,77	28,87				10 50	24.50	19.00	10.50	17.75	9.25	0.00	22.00	Ent.cld	13	12	13	S. W.	9	5	3	4	3	0	
																				S. E.	3	2	2	1	0	0	
	Range	1.23	1.29	1.20				36.00	29.50	34.00	40.00	29.75	41-75	27.36	29.50	Prt. clr.	8	14	11	W.	4	6	6	4	6	0	
																				E.	3	1	0	0	1	0	
Omitted			1						1			1	1	1	1			1				1		10	10	21	3.295

Average of 1841. — Average of Winter Months, 1840–41. — Average of Spring Months, 1841.

		Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. D.ff bet. dew point and therm.	Hygr'm'tr, 2 P.M. Wet bulb.
1841.	Average	29,475	29.452	29,462				46,70	57,81	49.39	43,86	51.24	44.49	14.01	51.31
	Maximum	30,14	30,15	30,10				80.00	92.50	80,00	78.00	83.75	74.17	47.21	73.00
	Minimum	28.53	28,57	28,59				-7.00	7,50	-1.00	-7.00	3.75	-29.71	0.00	7.50
	Range	1.61	1,58	1,51				87.00	85,00	81,00	85,00	80.00	103.88	47.21	70.50
	Omitted		8						8	3		8	9	9	9
Winter, 1840–41.	Average	29,43	29,39	29.45				25.09	35,76	28.89	22.70	29.17	24.80	10.98	32.49
	Maximum	30.14	30,15	30.10				46.50	55.00	50.00	36.00	45.50	55.00	47.21	55.00
	Minimum	28,79	28.78	28.78				-7.00	7.50	-1.00	-7.00	3,75	-29.71	0.00	7.50
	Range	1,35	1,37	1.32				53.50	47.50	51.00	43.00	41.75	84.71	47.21	47.50
	Omitted		1	1					1	1		1	1	1	1
Spring, 1841.	Average	29.44	29.42	29.41				44.99	57.44	47.15	40.60	49.22	42.01	15,52	49.96
	Maximum	29,94	29,92	29.91				71,00	84.50	73.00	66.50	75,25	68.56	38.15	73.00
	Minimum	28.53	28.57	28.59				18,50	28.00	25,00	18.50	26.50	1.15	0.00	25.50
	Range	1.41	1,35	1.32				52.50	56.50	48.00	48.00	48.75	67.41	38.15	47.50
	Omitted		2						2			2	2	2	2

Total of 1841. — Total of Winter Months, 1840–41. — Total of Spring Months, 1841.

	Sky.	7 A.M. D's	2 P.M. D's	9 P.M. D's
1841.	Ent. clr	98	42	135
	Ent. cld	132	99	109
	Prt. clr.	135	216	118
	Omitted		8	3
Winter, 1840–41.	Ent. clr	22	13	45
	Ent. cld	35	35	30
	Prt. clr.	33	41	14
	Omitted		1	1
Spring, 1841.	Ent. clr	20	11	27
	Ent. cld	39	27	33
	Prt. clr.	33	52	32
	Omitted		2	

	Winds.	Winds. 7 A.M. D's	Winds. 2 P.M. D's	Winds. 9 P.M. D's	Clouds. 7 A.M. D's	Clouds. 2 P.M. D's	Clouds. 9 P.M. D's	Rain. Rain gauge. In's
1841.	N.	38	28	36	6	19	2	
	N.W.	62	89	81	48	63	18	
	N.E.	61	48	55	9	12	0	
	S.	27	45	34	1	12	0	
	S.W.	89	61	59	37	37	11	
	S.E.	37	[illegible]	53	3	11	1	
	W.	32	18	33	67	90	18	
	E.	19	18	11	3	13	1	
	Omitted		8	3	99	76	180	37.430
Winter, 1840–41.	N.	5	6	4	2	1	0	
	N.W.	18	20	27	7	12	4	
	N.E.	21	16	15	0	0	0	
	S.	4	5	7	0	0	0	
	S.W.	22	17	13	4	2	3	
	S.E.	3	1	7	0	0	0	
	W.	14	21	16	21	23	6	
	E.	3	3	0	0	0	0	
	Omitted		1	1	36	39	32	11.880
Spring, 1841.	N.	9	6	10	3	2	0	
	N.W.	16	25	21	20	24	8	
	N.E.	20	12	15	3	4	0	
	S.	6	7	9	0	2	0	
	S.W.	17	15	9	7	12	1	
	S.E.	11	8	18	1	4	1	
	W.	9	11	5	17	19	6	
	E.	4	6	5	1	3	0	
	Omitted		2	0	22	15	49	10.373

Meteorological Journal—Continued.

Average of Summer Months, 1841.															*Total of Summer Months, 1841.*											
	Barometer.			Attached Thermometer.			External Thermometer.					Hygr'm'tr, 2 P.M.			Sky.				Winds.				Clouds.			Rain.
	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Dew point.	Diff bet. dew point and therm	Wet bulb.		7 A.M. D's	2 P.M. D's	9 P.M. D's		7 A.M. D's	2 P.M. D's	9 P.M. D's	7 A.M. D's	2 P.M. D's	9 P.M. D's	Rain gauge. In's.
Summer, 1841. Average	29.54	29.53	29.52	69.02	80.84	73.06	67.54	81.01	69.95	64.77	72.79	61.85	18.75	68.58					N.	10	6	7	1	8	1	
																			N.W.	13	16	15	9	11	3	
Maximum	29.85	29.84	29.85				80.00	92.50	80.00	78.00	83.75	74.17	32.37	78.00	Ent. clr	29	12	34	N. E.	11	11	10	5	5	0	
																			S.	12	19	10	1	5	0	
Minimum	29.27	29.25	29.21				57.00	63.00	58.00	54.00	62.50	45.58	0.00	59.00	Ent.cld	24	11	18	S. W.	23	15	23	15	11	3	
																			S. E.	15	5	19	1	6	0	
Range	.58	.59	.64				23.00	29.50	22.00	24.00	21.25	28.59	32.37	19.00	Prt. clr.	39	68	39	W.	4	15	6	19	29	6	
																			E.	4	4	2	2	5	1	
Omitted		1	1					1	1		1	1	1	1			1	1			1	0	14	8	45	3.020
Average of Autumnal Months, 1841.															*Total of Autumnal Months, 1841.*											
Autumn, 1841. Average	29.50	29.47	29.48	50.09	58.97	52.77	47.34	59.18	49.50	45.32	52.16	47.68	11.21	53.29					N.	14	9	12	1	8	0	
																			N. W.	18	28	20	13	15	3	
Maximum	29.96	29.90	29.91				71.50	88.00	77.50	71.50	78.25	73.50	24.63	74.00	Ent. clr	28	9	39	N. E.	12	9	15	1	3	0	
																			S.	6	14	9	0	5	0	
Minimum	28.93	28.90	28.97				17.00	30.00	21.00	16.00	25.75	16.62	0.00	27.00	Ent.cld	30	23	23	S. W.	22	15	14	8	9	4	
																			S. E.	6	4	8	1	1	0	
Range	1.03	1.00	.94				54.50	58.00	56.50	55.50	52.50	56.88	24.63	47.00	Prt. clr.	33	56	28	W.	8	5	8	16	21	3	
																			E.	5	4	4	0	4	0	
Omitted		3	1					3	1		3	3	3	3			3	1			3	1	23	17	42	7.162

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1841.
With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Jacquard Machinery for Weaving all kinds of figured goods;* Alexander Calderhead, city of Philadelphia, February 3.

The patentee says—"The nature of my improvement consists, first, in lifting and lowering the threads of the warp with what I call independent metallic heddles, or heylds, instead of the weights, males and twines composing the lower mountings, or harness, of the draw loom. Second—In constructing the cylinder, or pattern, so as to directly lift and receive the said heddles, to form the sheed, or shive; or in constructing a trunk and pattern web, both to direct what shall be the sheed as it does in the Jacquard and other drawing machines by trapping or untrapping the hooks, or knot cords, to be drawn up."

"I claim, as my invention, the principle of lifting the sheed, or shive, with metallic heddles directly by the pattern apron and trunk, roll or receiver, or by lowering the heddles into the same, as described."

2. For a machine for *Manufacturing Cannon Balls, Bullets, and other kinds of Shot* from malleable iron; Lewis Grandy and Thomas Osgood, city of Troy, Rensselaer county, New York, February 3.

"The metal from which the ball, or bullet, is to be made by means of our machine, is first to be formed into round bars of a size adapted to the kind of shot to be formed. When these are to be made of malleable iron, the metal must, preparatory to its being passed into the machine, be brought to a degree of heat nearly equal to that requisite for welding, in a suitable forge, or furnace, prepared for that purpose. When the balls, or bullets, are to be made from lead, or other soft metal, the heating process is omitted. The machine consists of suitable cutters for cutting off the proper quantity of metal from the bar to form a single ball, or shot, and of an apparatus for receiving the piece so cut off, and rolling it into the spherical form. The rolling is effected by means of channeled pieces of cast iron, or steel, which we will denominate swages. The channels in these, when the swages are made straight, are semi-cylindrical, and by placing swages in pairs, one over the other, with their channels coinciding, a cylindrical cavity is thereby formed. These swages may be either straight or circular; and to one, or to both, of each pair, a longitudinal, reciprocating, or a revolving, motion, as the case may be, must be communicated by suitable machinery.

"Having thus fully described the nature of our machine for manu-

facturing ball and shot, and shown the manner in which the same operates, we do hereby declare that we do not claim either of the separate parts thereof as of our invention, nor do we intend to limit, or confine ourselves to the particular manner of connecting or giving motion to the respective parts, but to use any of the devices, or means, for effecting these objects known to machinists; but what we do claim as constituting our invention, is the manner in which we have combined the cutting apparatus for separating the pieces of metal from the bars, with the reciprocating straight swages, or with revolving swages, or with straight and revolving swages combined, in such manner as that the pieces of metal cut off and to be rolled into balls, shall pass successively between two or more pairs of swages, in a machine constructed and operating substantially in the manner of that herein described."

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3. For an improvement in the manner of forming *Blocks of Wood for Pavements;* Stephen Carey, New Orleans, Louisiana, February 3, 1841. Patented for fourteen years from the 29th of January, 1839, the date of the English Patent.

"In forming my blocks for paving, I first cut them rectangularly, taking squared timber, generally of from nine inches to a foot, more or less, on each side, which timber I cross-cut into such lengths as may be thought suitable, according to the climate and other circumstances; these lengths, varying usually from nine to sixteen inches, those of the greatest length being required in climates where the ground is subject to be frozen to a considerable depth. The rectangular blocks, prepared as above described, are to be sloped, or beveled, on each of their four sides, said slopes or bends meeting at, or near, the middle of the length of each block, in consequence of which they become either wider or narrower in their measurement across the middle of each of their faces, than they are at their ends. In preparing my blocks I give to them three different forms, these being all that are necessary to their being combined together; one of these forms being that which would result from the uniting of two truncated rectangular pyramids by their larger ends; a second form is that which would be produced by joining such truncated pyramids by their smaller ends; and the third is a combination of the other two forms, two of its opposite sides having the first, and its other two sides the second forms."

Claim.—"Having thus fully described the manner in which I form and combine my blocks for the construction of pavements, what I claim as constituting my invention, and desire to secure by letters patent, is the giving to their sides, where they come into contact with each other, concave and convex faces, alternately, in the manner herein fully set forth, by which mode of forming and combining them they are each supported by, and aid in supporting, the surrounding blocks, as described; it being distinctly understood that when one side of a block is convex its opposite side is so likewise, and vice versa."

4. For improvements in the machine for *Splitting Leather, or Green Hides;* Alpha Richardson, Boston, Massachusetts, February 9.

The above named patent is for improvements on the machines that split the leather by means of a vibrating knife.

The gauge roller, which is placed above the knife to gauge the thickness of the grain side of the leather, works on pivot screws at each end, that pass through two arms projecting from a tubular shaft, within which a shaft revolves to communicate motion to the gauge roller by means of two chain bands, one at each end, that pass through openings in the tubular shaft. The table, or bed, against which the cutting is effected, rests on springs, and on its upper surface there is a revolving, elastic, steel rod, against which the flesh side of the leather is borne, and which yields to the inequalities in the surface of the leather. The split leather, or skin, is drawn through, to feed the machine, by means of three rollers geared together.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined the gauge roller, the shaft by which it is driven, and the tubular shaft, so as to give the revolving motion to the gauge roller by means of the chain bands. I claim, also, the use of the elastic steel rod, in combination with the elastic plate, or table, arranged and operating as described. I claim, likewise, the combining with such a machine, the drawing, or feeding rollers, operating in the manner, and for the purpose set forth. I do not claim to have invented any thing new in the general mode of gearing or of employing springs, and adjusting screws, these being common to machines used for the same, and for other purposes, but I confine my claim to the particulars above stated, with such variations thereof as will be substantially the same, producing a like effect by analogous means."

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5. For improvements in *Smelting Iron Ores;* Charles Sanderson, Sheffield, England, February 9.

"The object of my invention for certain improvements in the art or process of smelting iron ores, is to separate the scoria, slag, or other earthy or extraneous matters, from the metallic parts of such ores in a better and more economical manner than is commonly practiced in the smelting of iron ores, and the invention embraces a novel or improved manner, or method, of treating or operating upon such ores, whereby I am enabled to separate and remove the scoria, or earthy matters, contained therein, from the metallic parts, without the necessity of carbonizing the metallic parts so thoroughly as to cause them to melt together into a fluid state as they do in the common blast furnace; but my method consists in carbonizing the metallic parts to that extent which will enable them to separate from the scoria during the process of melting, whereby I am enabled to separate the metallic parts from the scoria without the necessity of melting both at the same time into a fluid state and running off the fluid iron from the scoria, or slag, as is the usual practice in the blast furnace; that is to say, I so treat and operate upon the ore, that I reduce the scoria, or other

extraneous matters contained therein, to a fluid state, so that the same will separate from the metallic parts and run off, leaving the metal without its changing into a fluid form—but in a sort of pasty consistency and in a fit state to be removed from the furnace, and applicable to various purposes, particularly to the making of bar iron."

The claims refer throughout to numerous drawings, and are therefore omitted.

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6. For improvements in *Locomotive Engines for Railways;* Henry Waterman, city of Hudson, Columbia county, New York, February 9.

The character of this invention is given with sufficient clearness in the claims made, which are as follows: "What I claim as my invention, and desire to secure by letters patent, is the particular mode of connecting the rear and front driving wheels by means of jointed rods placed at each end of said axle, so constructed as to enable the wheels to have a lateral and vertical motion to enable them to accommodate themselves to the curvature of the track, and pass over whatever obstacles may intervene without danger to the engine. And in connecting the main boxes of the main driving axle to the base of the cylinder, or other convenient place, by jointed rods so as to hold them firmly, and thus resist the strain on the axle and joints of the ordinary frame produced by the oscillating action of the pistons and their connexions; and thereby to dispense with the usual frame and pedestals, which, with the boxes, are constantly liable to wear, from the causes before stated; and I claim the above mentioned improvements whether they are effected in the manner herein set forth, or in any other mode substantially the same, and the last named improvement to be applied also to engines having but one pair of driving wheels."

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8. For an improvement in the machine for *Scraping Skins, or Hides, preparatory to Tanning;* Reuben Shailer, Haddam, Connecticut, February 9.

This improvement was added to a patent granted to Reuben Shailer on the 19th of June, 1837, noticed in this Journal, vol. xvii, 2nd series, p. 178. The improved apparatus consists of a cylinder with knives, scrapers, stones, or brushes, on its surface, against which the skin is pressed by means of a piece of leather attached to a hinged frame.

Claim.—"Having thus fully described the nature of my improvements in the within described machine for unhairing, scraping, and performing other analogous operations upon hides and skins, what I claim therein, and desire to secure by letters patent, is the affixing of the knives, scrapers, or other instruments, on to the periphery of a cylinder, in combination with a hinged frame sustaining a piece of leather, or other yielding material, the whole being constructed, arranged, and operating substantially in the manner herein set forth."

8. For improvements in *Piano Fortes;* Timothy Gilbert, Boston, Massachusetts, February 10.

Without the drawings we could not give a clearer idea of these improvements than will be conveyed by the claim alone, which is as follows:

Claim.—"Having thus described my improvements I shall claim the above arrangement of the parts of the action by which the spring after the strings are struck by the hammers performs the three operations of throwing back the hammer and preventing its recoil, throwing forward the damper upon the strings, and depressing the rear end of the key lever, consequently raising the opposite, or key, end; the whole being constructed and operating substantially as herein set forth. I also claim the mode of adjusting the end, or cloth, of the damper to the string, by means of a piece of wood, or spring, applied to the rear end of the key lever, and raised or lowered by a screw; and also the mode of adjusting the height of the jack by a similar contrivance applied to the same end of this key lever, the whole being arranged substantially as above described."

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9. For an improvement in the *Hammer Heads of Piano Fortes;* Timothy Gilbert, Assignee of Edwin Fobes, Boston, Massachusetts, February 10.

Claim.—"I claim forming the top of the hammer heads of piano fortes of cork, over which the soft buff leather, or striking part of the head, is to be stretched and confined in the usual manner."

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10. For an improvement in the *Cocks of Hydrants;* Ebenezer Hubball, Assignee of Joseph Martin, city of Baltimore, February 10.

The improvement is in the mode of raising the valve from its seat, which is effected by means of a screw-cap, turned by a winch, which works on a screw cut on the upper end of the valve rod.

Claim.—"The invention claimed, and desired to be secured by letters patent, consists in lifting the valve vertically, without any horizontal or grinding movement on its seat, by means of the before described revolving screw-cap and screw-head piston (valve) rod, whether constructed and arranged precisely in the manner above described, or in any other mode substantially the same."

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11. For improvements in *Clocks;* Aaron D. Crane, Newark, New Jersey, February 10, 1841; antedated December 22, 1840.

This clock, instead of being regulated by the vibrations of a pendulum, is regulated by the twisting and untwisting of a narrow strip of steel, to the lower end of which, a spherical weight is suspended. The twisting and untwisting of the strip of steel, which constitutes the pendulum rod, is effected by an arrangement of levers connected with the escapement wheel, but in a manner not easily explained in words without drawings. A rotary hammer, also, is employed in the striking

part, instead of the ordinary reciprocating hammer; this hammer is hung by a joint pin to the upper end of a vertical spindle, and is provided with a counter weight to balance it—both the hammer and counter weight, when lying horizontally, may rotate under the bell without striking it, but immediately in front of the bell there is a short inclined plane, which elevates the hammer sufficiently to cause it to strike as it approaches the bell, and then permits it to fall.

The time, or watch, part is driven by a spring, which is wound up by the striking of the clock, and the striking part is driven by a large spring, which is to be wound up in the usual way. On the arbor of one of the wheels in the train of the striking part, there is a barrel containing the spring of the time part, which barrel is connected with the train of the time part; this spring is attached to the arbor of the wheel in the striking train, and its other end forms the connexion with the time part by friction against the inner periphery of the barrel; when the clock strikes, this spring will consequently be wound up, and any excess of winding will be counteracted by the slipping of the spring on the inner periphery of the barrel.

Claim.—"The invention claimed, and desired to be secured by letters patent, is: first, the rotary pendulum; second, the rotary hammer in the striking part of the clock, and thirdly, the connection between the striking and time part of a clock, by which the time part is driven, all as described, and for the purpose above set forth."

In the construction of this time piece there is considerable ingenuity displayed, but we apprehend that the skill of the inventor would have been more profitably directed in the improving and manufacturing of clocks operated by the ordinary pendulum, which his tortion pendulum is hardly destined to supersede.

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12. For an improvement in the *Weighing Apparatus;* Christopher Edward Dampier, Ware, England, February 12.

A wheel or disk is hung by its axis to a suspended frame, provided with a pointer to indicate the graduations of pounds, &c., marked on the disk, as it turns under the action of the weights. A weight is attached by a joint pin to one disk, and on its opposite edge is the zero mark, from which commences the scale of pounds, and of parts thereof; the parts being so arranged as that when the whole is suspended, the weight shall be at the bottom, and zero under the pointer just above it. The dish, or scale, is hung to the edge of the wheel at right angles to the line, or diameter, running through the weight and zero of the scale. By attaching a lever to the disk in the line of its centre, the weights and dishes can be hung at different distances from the centre, and it thus acts as a steel yard, in addition to the constantly increasing weight or scale.

Claim.—"Now whereas, I claim as my invention, the application of a geometric scale, formed on the principle of the rules herein before given to a circular plate or disk, such plate or disk acting at the same time as a bent lever, and an equipoised balance beam for weighing

matter in the manner herein before described, and as an index of the weight so ascertained. And I claim also as my invention, the combination in operation of the aforesaid disk, acting as a bent lever, and the simple lever or steel yard as described, for ascertaining the weight of substances applied thereto, by means of graduated scales, as herein before mentioned, extending the operation of the disc acting as a bent lever to greater weights than marked upon the disc by means of the simple lever, or common steel yard."

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13. For an improvement in the *Corn Sheller;* Nicholas Goldsborough, Easton, Talbot county, Maryland, February 12.

This corn sheller consists of a cylinder armed with teeth in the usual way, which act in conjunction with a concave in stripping the grain from the cob. The concave is formed of a series of fluted iron rollers, twisted so as to make the flutes spiral; these are arranged in a frame hung on springs, within the frame of the machine.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the concave, consisting of revolving, twisted, fluted bars, and hung upon springs, in combination with the toothed cylinder, for the purpose and in the manner above specified."

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14. For an improvement in the *Plough;* Benjamin F. Jewett, Springfield, Sangamon county, Illinois, February 12.

The mould board of this plough is fastened to the sheath by rivets, which are cast with the sheath. The claim is confined to this mode of fastening the two parts together.

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15. For an improvement in the manner of constructing *Door and other Locks;* Solomon Andrews, Perth Amboy, Middlesex county, New Jersey, February 12.

The patentee says—"I denominate this lock 'the combined snail wheel lock,' which name is given to it on account of its principal characteristics being the causing of the key to carry around with it any desired number of wheels formed of flat plates of metal, which wheels revolve upon a centre pin, and are each of them perforated with a snail-like, or other suitably formed opening, within and upon which the bit of the key is to act."

The snail-like openings in all the wheels are alike, and the key is formed with projections on the bit of different lengths, one for each wheel, and as the key is turned, the projections being of different lengths, they will act upon the snail-like openings at different parts, and then carry the wheels around. Each of these wheels is provided with a recess so situated, as that when the projections on the bit of the key are all in contact with the wheels upon which they act, the recesses will all correspond, and receive the end of a pendulous lever, which is set in motion by the continued turning of the wheels, by which means the bolt of the lock is shot forward.

Claim.—"What I claim as new, and desire to secure by letters patent, are the use and employment of said combined wheels, having in them openings similar to those herein described, which wheels are to be operated upon within the snail-formed, or other, openings, and carried round to different distances by projecting pieces on the bit of the key, until a notch, or cavity, on the periphery of each wheel is brought to coincide with those on the other wheels with which it is combined, so as to admit of the opening of the lock, in the manner, or upon the principle, above set forth."

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16. For an improvement in the *Cooking Stove;* Clark Robinson, Union Town, Fayette county, Pennsylvania, February 13.

There is in this stove an arrangement of flues and dampers, by which the draught may be carried around the four sides of the oven in two different directions. The oven is below the fire chamber, and extends beyond it at the back of the stove, the plate that covers the flue at this part being provided with boiler holes, in addition to those directly over the fire. The chimney is situated behind the fire chamber, and over that part of the oven which extends in the rear of it. The bottom plate of the fire chamber does not extend to the back plate, and the intervening space is covered by a damper hinged to the back plate, and shutting down on a flanch on the back edge of the bottom plate. The back plate of the fire chamber is provided with four apertures, one on each side of the chimney, leading into the back flue, and two leading into the chimney, one of them above, and the other below, the bottom plate. From the above arrangement, it follows that, when the damper, which covers the opening in the bottom of the fire chamber, is thrown up, and thus closes the aperture in the back above the bottom plate, the smoke, &c., will pass out through this opening over the oven, down the front, along under the bottom, up the back, over so much of the top as extends back of the fire chamber, and then out at the chimney. When the damper is down and closes the opening in the bottom of the fire chamber, and the aperture leading into the chimney above the bottom of it, which is used only when kindling the fire, is closed, and the lower one leading into the chimney, and the two leading into the back flue are open, and the bottom of the chimney is closed; the smoke, &c., will then pass out from the fire chamber into the back flue, down the back, under the bottom, up the front, over the top, and then out into the chimney.

Under the hearth, and against the plate which forms the front flue, there is a square box, constituting an apparatus for roasting coffee, &c.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before mentioned arrangement, to give the flame, &c., any direction, forward or backwards, round the oven, by means of flues and dampers connected therewith, and the additional apparatus which is heated by the oven and hearth for roasting coffee, and for using as a spit as described."

17. For an improvement in the *Press for compressing Cotton, &c.;* Lemuel Bolles, Jedediah Prescott, and William A. Bickford, Memphis, Shelby county, Tennessee, February 13.

There is in this press a combination of jointed levers, press-blocks, a rack and pinion, and other devices, connected in such a manner as not to admit of a description in words alone, and the claims, which refer throughout to the drawings, would not convey any idea of the particulars of the invention.

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18. For an improvement in the mode of *Applying water to Fire Engines,* so as to render their operation more effective; Franklin Ransom and Uzziah Wenman, city of New York, February 13.

The pressure of a column of water, either from a reservoir or a hydrant, is to be applied by a pipe, or hose, to the cylinder, or cylinders of a fire engine, so that the pressure of the column may assist the power, or force, applied to the brake or levers.

Claim.—"What we claim as our invention, and wish to secure by letters patent, is the employing of the pressure of a column of falling water, or the tendency of the hydraulic pressure on water at rest, to assist in the working of fire engines, by combining a hose or pipe, conducting said water with the receiving tubes of an engine or pump, operated by animal or mechanical power, the same being constructed substantially in the manner set forth."

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19. For an improvement in the *Parlor Stove;* John Backus and Evans Backus, New York city, February 18.

The patentees say—"The nature of this stove consists in a combination of the radiator and the hollow base, by which combination the smoke is made to descend through the sides or ends of the stove into the hollow base, and to ascend thence through a draught pipe at the back of the stove; and while in this passage the smoke heats the air, which is constantly passing through the radiators, which are open at bottom and top, to allow free way for the atmosphere of the room."

"What we claim as our invention, and desire to have secured to us by letters patent, is the combination of the hollow base and the radiators."

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20. For an improvement in the *Fire Engine;* Asa Barrett, city of Baltimore, February 18.

The patentee observes that "the usual manner of ejecting water from the engine, is by means of the goose-neck pipe, which is from five to eleven feet long; the bore having a uniform taper through its whole length. Whereas, I contract the length of the joints and the eject-pipe to the short length of from fourteen to seventeen inches: the eject-pipe itself being from three to six inches long." To a pipe, connected with the engine by the usual lower joint of the branch pipe. (which the patentee calls the eject pipe,) a short cylinder is attached

at right angles to the length of the pipe. The branch pipe, which is very short, is attached to a cylinder which turns within that first named, the branch pipe passing through a slot in it of sufficient length to allow the pipe to play through a range of a quarter of a circle: the inner cylinder has a long opening in it to admit the water from the main pipe. The inner cylinder is provided with gudgeons at each end, that pass through the heads of the first mentioned cylinder, and these have a lever attached to them for the purpose of governing the elevation of the branch pipe.

Claim.—"I claim as my invention, and desire to secure by letters patent, the combination of the eject-pipe as above described, with a compact universal joint-pipe or duct, managed by a handle or lever, all constructed in the manner, and for the purpose above specified."

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21. For improvements in the machine for making *Cotton Roping*, commonly called "Counter twist Speeders;" Charles Danforth, Paterson, Passaic county, New Jersey, February 18.

Those who are acquainted with the operation of speeders will fully understand this invention from the following claim, viz:—"What I claim as my invention, consists of the following arrangement, viz: the turning of the cylinder which bears and drives the bobbins in a direction which makes the roping run on to the bobbins at the point of contact or bearing, between the bobbins and the said driving cylinder, the roping being made to pass between the condensing belt, or through the condensing tube, to said point of contact, in the direction of a tangent to said driving cylinder, whereby the bobbins take the roving at such a distance from the nearer edge of the said belt or tube, as to be within the length of the fibre, and thereby the roping is not liable to be strained after passing upon the bobbin, as may be the case in machines, which deliver the roving through guides to the top or sides of the bobbins; the guides in my machine being made to deliver the roping filament to the condensing belt, and this being placed on a line with the top of the driving cylinder, so as to deliver the roping as near as may be in the direction of a tangent, as aforesaid."

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22. For improvements in machinery for *Trimming Straw Braid;* Henry H. Robbins, Middleborough, Plymouth county, Massachusetts, February 18.

This machine is for the purpose of trimming the long and the short ends of straw left on the two surfaces after braiding, the short ends being left on one side, and the long ends on the other.

The claim presents the general arrangement of the parts of this apparatus as clearly as can well be done, without a drawing.

Claim.—"I claim as my invention, the combination of a revolving circular saw with a riser, (so called), and a spring and gauge, the whole being arranged and operating substantially as herein above described, for the purpose of separating the long ends from the braid; and I also claim separating the short ends from the braid on the opposite side of

the same, by means of a circular saw in combination with a small metallic roller, bed knife and gauge, the arrangement and operation being substantially as specified."

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23. For an improvement in the *Nurse Bottle*, denominated a Lacteal or Artificial Breast; Charles M. Windship, Roxbury, Norfolk county, Massachusetts, February 18.

"The great objection to the common nursing bottle is, that it is exceedingly difficult to teach most infants to use them, and with many it is altogether impracticeable. The peculiar formation of my lacteal breast remedies this objection and enables me to practice a useful deception, viz: inducing the child to think that it derives its nourishment directly from the mother, as it feeds in the natural position."

The bottle is made concave on the under side to rest on the breast, and on the upper side swelled out in form of the natural breast, with a neck in the middle, in the form of a nipple, and a tube at one side through which the milk is introduced.

Claim.—"I shall claim as my invention a nurse-bottle, shaped and curved in its several parts, so as to be used at the breast, and formed with a neck and mouth substantially as described. And I also claim in combination with the above, an artificial nipple, composed of sponge and wash leather, the whole forming what I denominate a lacteal or artificial breast, as above specified."

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24. For improvements in the *Press for filling War Rockets;* Alvin C. Goell, Washington city, District of Columbia, February 18.

"What I claim as constituting my invention in the above press, and desire to secure by letters patent, is the manner of combining a system of weighted levers with a screw, by causing a piston, or rod, to extend through a tubular opening in said screw, the lower end of said piston, or rod, acting against a follower, rammer, or other device analogous thereto in character and use, and its upper end acting upon a system of compound levers, by which the actual amount of pressure made may be ascertained and determined, substantially in the manner, or upon the principle, set forth. I also claim the manner of combining two, or more moulds, to be alternately brought under the pressing screw and piston, by the revolution of the basis on which they are situated, so that those not under the press, may be prepared for its action during the time of making pressure upon that which is in the proper situation."

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25. For an improvement in the *Cooking Stove;* Jefferson Cross, Morrisville, Madison county, New York, February 18.

The improvement referred to is added to a patent granted to the same person on the 27th of June, 1838, and noticed in this Journal, vol. xxiii, 2nd series, p. 400.

The patentee says—"In my stove, as originally constructed, there was a cylindrical elevated oven which was supported on two pillars,

or pipes, about one foot five or six inches in length, and when baking was to be effected, the heated air from the fire was allowed to pass up through these pipes and to circulate around the oven, as in some other stoves with elevated ovens. For carrying the draught directly into the main flue, when the oven was not to be used, it was led off by a flue projecting about one foot backwards from the body of the stove. By my present improvement I dispense with the pipes, or tubes, which sustained the oven, and conducted the heated air into the flue surrounding it; said oven being elevated above the top plate of the stove but little more than its diameter. I have also arranged the flue for carrying off the smoke and heated air in such manner as to change the direction of the draught by the action of a single valve, or damper, instead of by three, as in my former plan. The oven flue and stove flue communicate with each other through an opening nearly the whole length of the oven. Directly in front of the oven a pipe extends from the stove flue to a box above the oven, (the upper plate of which is provided with boiler holes) which communicates with the upper part of the oven flue and with the chimney; where the oven flue runs into the box it is provided with a damper to direct the draught either through the oven flue or through the front pipe, under the boilers, in the top plate of the box."

"What I claim, and desire to secure by letters patent, is the manner in which I have combined the elevated oven with the stove, by admitting the draught from the fire to pass from the stove directly into the oven flue through an opening extending nearly the whole length of the oven, as set forth. I also claim the manner of arranging and combining the flue, (pipe in front of the oven,) the box, and the valve, so as to direct the draught, by the shifting of said valve, either around the oven or through the pipe, for the purpose, and substantially in the manner, herein described."

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26. For an improvement in the *Machine for Inking Types;* Frederick J. Austin, city of New York, February 20.

This patent is taken for an alleged improvement in the well known inking apparatus of the printing press, and consists in an arrangement of levers, &c., for moving the inking roller over the form.

An arm extending from the sliding frame that carries the inking roller, is jointed to a lever attached to an arbor, from which projects another and shorter lever, at right angles to the first. The last mentioned lever is connected by means of a connecting rod, with a crank, the shaft of which is provided with a pulley and weight, by which the roller, when liberated, is moved over the form of types.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar mode of throwing the roller across the form by means of the lever and connecting rod combined and attached to the crank on the shaft of the pulley; said pulley being operated upon by the weight."

27. For an improvement in *Grinding Mills;* Ezekiel G. Ward, city of New York, February 20.

This grinding mill is a modification of the cast iron mill, the runner of which operates vertically. The improvements are clearly explained in the following claim, viz:—

"I am aware," the patentee observes, "that mills have been made with the grinders revolving vertically, and that the grinders of mills have been made so that they shall be removed from the shaft, and these I do not therefore claim as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the manner in which the grinders are connected with the case and shaft so that they can be removed with pleasure and without injury to any part of the mill; that is to say, I claim connecting the front grinder with the case by means of the steps fitting into notches in the mill case, in combination with the method of attaching the back grinder to the shaft by means of the flanch on the shaft having notches into which fit steps projecting from the back of the grinder, the shaft passing through the two grinders by which they are centered, and the grinding being regulated by pressing the flanch against the back of the back grinder, all as described."

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28. For an improvement in the *Stump Extractor;* Belden B. Mason, Randolph, and Mathews Joslyn, Napoli, Cattaraugus county, New York, February 20.

The improvement here patented is on that kind of stump machine in which the stump is extracted by means of a screw attached to it by means of chains, and passing through a nut attached to the upper part of a frame.

The patentee says—"We do not claim as our invention the method of extracting stumps by means of a screw passing through the nut in the upper part of the frame, as this has been before effected; but in these cases the nut being permanently and immovably fixed to the frame, the screw was liable to be bent, and therefore what we claim as our invention, and as an improvement on such a machine, is the employment of the semi-spherical nut and socket in combination with the screw and chain by which the stump is griped, for the purpose and in the manner specified."

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29. For an improvement in *Head Blocks for Saw Mills;* James King, Sapling Grove, Washington county, Tennessee, February 20.

The object of the improvement in the head blocks of saw mills, is the gauging the thickness of the board to be cut, and this is to be effected by means of a block of wood furnished with a slot, through which a screw bolt passes to fasten it to the head block, and to allow it to slide towards, or from, the saw. The distance of this block from the saw is regulated by a wedge which is driven in between it and a standard attached to the head block.

Claim.—"I am aware," the patentee observes, "that the head blocks

of saw mills have been provided with a sliding gauge for gauging the thickness of the board to be cut, and that the slide has been moved by a screw passing through a standard and acting on the sliding gauge, and that it has also been connected with a hinge frame by means of screws passing through a slot in the slide to allow of its sliding nearer to, or further from, the saw, and therefore I do not claim all this as of my invention; but what I do claim as my invention, and desire to secure by letters patent, is the peculiar manner in which I have constructed and combined the various parts, that is to say, I claim the sliding block, provided with a slot through which the screw bolt passes, to fasten it to the head block, in combination with the standard, the space between the two being occupied by a wedge to determine the thickness of the board to be cut, as described."

30. For an improvement in the manner of *Fastening Bedsteads;* Hermann C. Ernst, Vandalia, Fayette county, Illinois, February 23.

In the improved mode of fastening, which is the subject of this patent, the posts are to be attached to the rails by a piece of cast iron, somewhat in the form of an anchor. That part which corresponds to the stem is round, and is received in a hole in the inner corner of the post, and each end of the head is provided with a round tenon, which is received in a hole made in the inner side of the rail. There are also two square tenons on the stem, within the anchor head, which fit into mortises in the rails, and come against the two inner sides, or faces, of the post.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the casting nearly in the shape of an anchor, for the purpose of confining the rails and posts of bedsteads to each other."

31. For an improvement in *Making Brushes;* Robert B. Lewis, Hallowell, Kennebeck county, Maine, February 23.

This patent is for a mode of attaching the bristles, &c., to the handles of brushes for white washing and for such other purposes as require brushes to be wide and thin. The bristles are placed on each side of a double champfered bar, and are then confined by a metallic band, made in two parts and jointed at each end. In this manner the bristles are confined by being pinched between the side plates, or band, and the champfered bar.

Claim.—"Having thus described my improvements, I shall claim as my invention as follows, viz:—Confining the bristles in a brush (more effectually than before) by means of a double champfered bar, (whose section would be elliptical and on which the bristles are placed,) in combination with the metallic band, which is formed of two parts united by joints and pins, as described, the whole being arranged substantially in the manner and for the purpose set forth."

32. For improvements in *Machinery for Manufacturing Ploughs;* Draper Ruggles, Joel Nourse, and John C. Mason, Assignees of Elbridge G. Matthews, Worcester, Massachusetts, February 23.

The inventor says—"The nature of my invention consists in giving, by appropriate machinery, a uniform tenon and shoulder to the beam of each sized plough without the use of square, compass, or level; a method of cornering the beams in a manner befitting each size, and also a method of setting out the mortise in the handle and bringing all the parts together with an accurate fit, in conformity with such preparatory operations; altogether tending to the result above mentioned."

The claims refer throughout to the drawings, and could not be understood without them.

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33. For an improvement in the manner of *Fastening and Combining the Truss Frames of Bridges*, and which may be applied to other purposes; Jehu Price and James T. Phillips, Golden Post Office, Baltimore county, Maryland, February 23.

We make the following extract from the specification, viz:—"The peculiarity in the manner of fastening our truss frames and combining them with each other, consists in the employing of the pieces of timber last inserted in putting together the truss frame, in such a way as to cause them to operate as keys, and to bind the whole frame together without its being necessary to use pins, tree-nails, bolts, wedges, or other devices analogous thereto, excepting for fastening down the floor timbers, or such as may be employed in covering in. From the circumstance of these last inserted timbers keying the whole together in a manner similar to the binding together of the toy sometimes called a 'puzzle knot,' we have denominated our bridge the 'Puzzle Keyed Bridge.'"

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the within described manner of fastening, and combining together the truss frames of bridges, or of other structures, by the insertion of timbers which constitute key pieces, or cross ties, as set forth, so as to obviate the necessity of using pins, tree-nails, screw-bolts, or other analogous devices."

Report from the Commissioner of Patents, showing the operations of the Patent Office during the year 1841.

PATENT OFFICE, *January*, 1842.

SIR: In compliance with the law, the Commissioner of Patents has the honor to submit his annual report.

Four hundred and ninety-five patents have been issued during the year 1841, including *fifteen* additional improvements to former patents; of which classified and alphabetical lists are annexed, marked A and B.

During the same period, *three hundred and twenty-seven* patents have expired, as per list marked C.*

The applications for patents, during the year past, amount to *eight hundred and forty-seven;* and the number of caveats filed was *three hundred and twelve.*

The receipts of the office for 1841 amount to $40,413.01; from which may be deducted $9,093.30, repaid on applications withdrawn.

The ordinary expenses of the Patent Office for the past year, including payments for the library and for agricultural statistics, have been $23,065.87; leaving a surplus of $8,253.84 to be credited to the patent fund, as per statement marked E.

For the restoration of models, records, and drawings, under the act of March 3, 1837, $20,507.70 have been expended, as per statement marked F.

The whole number of patents issued by the United States, previous to January, 1842, is *twelve thousand four hundred and seventy-seven.*

The extreme pressure in the money market, and the great difficulty in remittance, have, it is believed, materially lessened the number of applications for patents. These have, however, exceeded those of the last year by *eighty-two.*

The resolution of the last Congress, directing the Commissioner to distribute seven hundred copies of the Digest of Patents among the respective states, has been carried into effect, as ordered.

Experience, under the new law reorganizing the Patent Office, shows the importance of some alterations in the present law. One difficulty has been hitherto suggested, viz: the want of authority to refund money that has been paid into the Treasury for the Patent Office, by mistake. Such repayment cannot now be made without application to Congress. The sums, usually, are quite small, not exceeding $30. A bill has been heretofore presented, embracing these cases, and passed one House of the National Legislature; but a general law would save much legislation, and be attended with no more danger than now attends the repayment of money, on withdrawing applications for patents. Indeed, several private petitions are now pending before Congress, and are postponed, to wait final action on the bill which has been so long delayed.

Frauds are practised on the community by articles stamped "pattent," when no patent has been obtained; and many inventors continue to sell, under sanction of the patent law, after their patents have expired. To remedy these evils, the expediency of requiring all patentees to stamp the articles vended with the date of the patent, and punishing by a sufficient penalty the stamping of unpatented articles as patented, or vending them as such, either before a patent has been obtained or after the expiration of the same, is respectfully suggested. Almost daily inquiries at the Patent Office exhibit the magnitude of such frauds, and the necessity of guarding effectually against them.

The justice and expediency of securing the exclusive benefit of new and original designs for articles of manufacture, both in the fine and

* For list marked C, see page 281; the others are omitted.

useful arts, to the authors and proprietors thereof, for a limited time, are also respectfully presented for consideration.

Other nations have granted this privilege, and it has afforded mutual satisfaction alike to the public and to individual applicants. Many who visit the Patent Office learn with astonishment that no protection is given in this country to this class of persons. Competition among manufacturers for the latest patterns prompts to the highest effort to secure improvements, and calls out the inventive genius of our citizens. Such patterns are immediately pirated, at home and abroad. A pattern introduced at Lowell, for instance, with however great labor or cost, may be taken to England in twelve or fourteen days, and copied and returned in twenty days more. If protection is given to designers, better patterns will, it is believed, be obtained, since the impossibility of concealment at present forbids all expense that can be avoided. It may well be asked, if authors can so readily find protection in their labors, and inventors of the mechanical arts so easily secure a patent to reward their efforts, why should not discoverers of designs, the labor and expenditure of which may be far greater, have equal privileges afforded them?

The law, if extended, should embrace alike the protection of new and original designs for a manufacture of metal, or other material, or any new and useful design for the printing of woolen, silk, cotton, or other fabric, or for a bust, statue, or bas-relief, or composition in alto or basso-relievo. All this could be effected by simply authorizing the Commissioner to issue patents for these objects, under the same limitations and on the same conditions as govern present action in other cases. The duration of the patent might be *seven* years, and the fee might be *one-half* of the present fee charged to citizens and foreigners, respectively.

On the first alteration of the patent law, I would further respectfully recommend, that authority be given to consuls to administer the oath for applicants for patents. Inventors in foreign countries usually apply to the diplomatic corps, who are willing to aid any, and have uniformly administered the usual oath prescribed by the Commissioner of Patents; but as the Attorney General has decided, that consuls cannot, within the meaning of the patent law, administer oaths to inventors, a great convenience would attend an alteration of the law in this respect.

It is due to the clerical force of the office to say, that their labors are arduous and responsible—more so than in many bureaux—while the compensation for similar services in other bureaux is considerably higher. A comparison will at once show a claim for increased compensation, if uniformity is regarded. The chief and sole copyist of the correspondence of this office receives only eight hundred dollars per annum.

The Commissioner of Patents also begs leave to suggest the expediency of including the annual appropriations for the Patent Office in the general bill which provides for other bureaux. Objections hitherto urged against this course, inasmuch as the Patent Office is embraced by a special fund, have induced the committee to report a spe-

cial bill, which, though reported without objection, has failed for two sessions, because the bill could not be reached, it having been classed with other contemplated acts on the calendar, instead of receiving a preference with other annual appropriations so necessary for current expenses. Were the appropriation for the Patent Office included in a general bill, also designating the fund from which it was to be paid, all objection, it is believed, might be obviated.

During the past year a part of the building erected for the Patent Office has, with the approbation of the Secretary of State, been appropriated to the use of the National Institute, an association which has in charge the personal effects of the late Mr. Smithson, collections made by the exploring expedition, together with many valuable donations from societies and individuals. While it affords pleasure to promote the welfare of that institution by furnishing room for the protection and exhibition of the articles it has in charge, I feel compelled to say that the accommodation now enjoyed can be only temporary. The large hall appropriated by law for special purposes will soon be needed for the models of patented articles, which are fast increasing in number by restoration and new applications, and also for specimens of manufacture and unpatented models. An inspection of the rooms occupied by the present arrangement will show the necessity of some further provision for the National Institute.

The Patent Office building is sufficient for the wants of the Patent Office for many years, but will not allow accommodation for other objects than those contemplated in its erection. The design of the present edifice, however, admits of such an enlargement as may contribute to its ornament, and furnish all necessary accommodation for the National Institute; and also convenient halls for lectures, should they be needed in the future disposition of the Smithsonian legacy. Whatever may be done as regards the extension of the present edifice, it is important to erect suitable outbuildings, and to enclose the public square on which the Patent Office is located.

Some appropriation, too, will be needed for a watch. So great is the value of the property within the building, that a night and day watch is indispensable. The costly articles formerly kept in the State Department for exhibition are now transferred to the National Gallery, where their protection will be less expensive than it was at the State Department, since these articles are guarded in common with others. The late robbery of the jewels, so termed, shows the impropriety of depending on bolts and bars, as ingenuity and depravity seem to defy the strength of metals. A careful supervision at all times, added to the other safeguards, is imperiously demanded. I am happy to say that no injury or loss will be sustained from the robbery just alluded to, with the exception of the reward so successfully offered for the recovery of the articles.

By law, the Commissioner is also bound to report such agricultural statistics as he may collect. A statement annexed (marked G) will show the amount of wheat, barley, oats, rye, buckwheat, Indian corn, potatoes, cotton, tobacco, sugar, rice, &c., raised in the United States

in the year 1841. The amount is given for each state, together with the aggregate. In some states the crop has been large, in others there has been a partial failure. Upon the whole, the year has been favorable, affording abundance for home supply, with a surplus for foreign markets, should inducements justify exportation.

These annual statistics will, it is hoped, guard against monopoly or an exorbitant price. Facilities of transportation are multiplying daily; and the fertility and diversity of the soil ensure abundance, extraordinaries excepted. Improvements of only ten per cent. on the seeds planted will add annually from fifteen to twenty millions of dollars in value. The plan of making a complete collection of agricultural implements used, both in this and foreign countries, and the introduction of foreign seeds, are steadily pursued.

It will also be the object of the Commissioner to collect, as opportunity offers, the minerals of this country which are applied to the manufactures and arts. Many of the best materials of this description now imported have been discovered in this country; and their use is only neglected from ignorance of their existence among us. The development of mind and matter only leads to true independence. By knowing our resources, we shall learn to trust them.

The value of the agricultural products almost exceeds belief. If the application of the sciences be yet further made to husbandry, what vast improvements may be anticipated! To allude to but a single branch of this subject. Agricultural chemistry is at length a popular and useful study. Instead of groping along with experiments, to prove what crops lands will bear to best advantage, an immediate and direct analysis of the soil shows at once its adaptation for a particular manure or crop. Some late attempts to improve soils have entirely failed, because the very article, transported at considerable expense to enrich them, was already there in too great abundance. By the aid of chemistry, the west will soon find one of their greatest articles of export to be oil, both for burning and for the manufactures. So successful have been late experiments, that pork (if the lean part is excepted) is converted into stearine for candles, a substitute for spermaceti, as well as into the oil before mentioned. The process is simple and cheap, and the oil is equal to any in use.

Late improvements, also, have enabled experimenters to obtain sufficient oil from corn meal to make this profitable, especially when the residuum is distilled, or, what is far more desirable, fed out to stock. The mode is by fermentation, and the oil which rises to the top is skimmed off, and ready for burning without further process of manufacture. The quantity obtained is ten gallons in 100 bushels of meal. Corn may be estimated as worth fifteen cents per bushel for the oil alone, where oil is worth $1.50 per gallon. The extent of the present manufacture of this corn oil may be conjectured from the desire of a single company to obtain the privilege of supplying the lighthouses on the upper lakes with this article. If from meal and pork the country can thus be supplied with oil for burning and for machinery and manufactures, chemistry is indeed already applied most beneficially to aid husbandry.

A new mode of raising corn trebles the saccharine quality of the stalk, and, with attention, it is confidently expected that 1,000 pounds of sugar per acre may be obtained. Complete success has attended the experiments on this subject in Delaware, and leave no room to doubt the fact that, if the stalk is permitted to mature, without suffering the ear to form, the saccharine matter (three times as great as in beets, and equal to cane) will amply repay the cost of manufacture into sugar. This plan has heretofore been suggested by German chemists, but the process had not been successfully introduced into the United States, until Mr. Webb's experiments at Wilmington, the last season. With him the whole was doubtless original, and certainly highly meritorious; and, though he may not be able to obtain a patent, as the first original inventor, it is hoped his services may be secured to perfect his discoveries. It may be foreign to descend to further particulars in an annual report. A minute account of these experiments can be furnished, if desired. Specimens of the oil, candles, and sugar, are deposited in the National Gallery.

May I be permitted to remark that the formation of a National Agricultural Society has enkindled bright anticipations of improvement. The propitious time seems to have come for agriculture, that long neglected branch of industry, to present her claims. A munificent bequest is placed at the disposal of Congress, and a share of this, with private patronage, would enable this association to undertake, and, it is confidently believed, accomplish much good.

A recurrence to past events will show the great importance of having annually published the amount of agricultural products, and the places where either a surplus or a deficiency exists. While Indian corn, for instance, can be purchased on the western waters for one dollar (now much less) per barrel of 196 pounds, and the transportation, via New Orleans, to New York, does not exceed $1.50 more, the price of meal need never exceed from eighty cents to one dollar per bushel in the Atlantic cities. The aid of the National Agricultural Society, in obtaining and diffusing such information, will very essentially increase the utility of the plan before referred to, of acquiring the agricultural statistics of the country, as well as other subsidiary means for the improvement of national industry.

I will only add that, if the statistics now given are deemed important, as they doubtless may prove, to aid the Government in making their contracts for supplies, in estimating the state of the domestic exchanges, which depend so essentially on local crops, and in guarding the public generally against the grasping power of speculation and monopoly, a single clerk, whose services might be remunerated from the patent fund, to which it will be recollected more than $8,000 has been added by the receipts of the past year, would accomplish this desirable object. The census of population and statistics, now taken once in ten years, might, in the interval, thus be annually obtained sufficiently accurate for practical purposes.

All which is respectfully submitted.

HENRY L. ELLSWORTH.

Hon. JOHN WHITE, *Speaker of the House of Representatives.*

List of American Patents that expired in the year 1841.

Alarm for coaches, W. Hunt, N. Y., July 30.
Andirons, constructing feet of brass, J. Griffiths, N. Y., March 15.
Andirons, pedestal, Edmd. Smylie, N. Y., Feb. 1.
Andirons, repairing and finishing, Edmd. Smylie, N. Y., Feb. 22.
Apple mill, H. E. Paine and S. H. Russell, Le Roy, Ohio, March 5.
Apples, machine for grinding, Const. Weeks, Paris, N. Y., April 9.
Aqueduct, J. M. Benham, Bridgewater, N. Y., Aug. 29.
Auger, screw, Judson Smith, Derby, Conn., July 13.
Axletrees and boxes, Cyrus Beach, Newark, N. J., June 26.
Bark mill, cast iron, Wm. Torrey, Westbrook, Me., Sept. 13.
Bed-sacking, mode of tightening, J. R. Simpson, Boston, Mass., July 10.
Bedsteads, sacking bottoms, &c., Dan. Powles, Baltimore, Md., Jan. 26.
Beehive, Cuthbert Wiggins, Fayette, Pa., Feb. 27.
Bellows, Jesse Dixon, Pittsborough, N. C. June 11.
Bellows, J. S. Wilberts, Chili, N. Y., June 12.
Beer, brewing spruce, Wm. Dezeau, Philadelphia, Pa., May 31.
Blower for coal grates, R. Fuller and T. Thomas, N. Y., May 22.
Blowing and striking for blacksmiths, L. Hoyt and E. Pierce, Poultney, N. Y. March 3.
Boat, passing canal locks, R. Graves, Brooklyn, N. Y., July 26.
Boats, for transporting on canals, &c., R. P. Bell, N. Y., July 13.
Bobbin, tube for spinning cotton, B. Hutchison, Philadelphia, Pa., Oct. 18.
Bogging machine, Squire Collins, Hillsdale, N. Y., Feb. 22.
Boilers for anthracite, J. Barker, Baltimore, Md., Feb. 7.
Boilers, supplying steam uniformly, I. Doolittle, Bennington, Vt., June 1.
Boilers, constructing steam, Eb. A. Lester, Boston, Mass., May 14.
Boilers for steam engines, J. Pool, Sheffield, England, May 14.
Boot, constructing, T. Thorp, Richmond co., N. C., Aug. 31.
Boot crimper, Saml. Moorehouse, Eastport, Me., June 19.
Boots or shoes, mode of holding, Saml. Nourse, Danvers, Mass., Dec. 8.
Boring earth, J. R. Failing, Canajoharie, N. Y., June 13.
Boring and tenoning machine, D. Sperry, Colchester, Conn., Feb. 18.
Boxes, self-fastening, T. Mussey, New London, Conn., June 11.
Brick frames, for raising portable, E. Mann and G. Hill, Rochester, N. Y., July 21.
Brick press, A. B. Crossman, Huntington, N. Y., Feb. 9.
Brick press, John Howe, Alna, Me., May 18.
Brick press and moulding, J. McDonald, N. Y., April 24.
Brick machine, D. Rising, Alchester. Vt., March 21.
Brick and tile machine, E. Fisk and B. Hinkley, Fayette, Me., Sept. 8.
Bricks, machine for mixing earth for, D. K. Hill, Richmond co., Geo., Feb. 17.
Bridges, Wm. Woodmansee, Kingston, N. Y., March 6.
Bridges, T. P. Bakewell, Pittsburg, Pa., May 15.
Bridges with draws, G. Wilkinson, White Creek, N. Y., May 5.

Bugle, Kent, R. Willis, West Point, N. Y., Nov. 10.
Building vessels, &c., T. W. Bakewell, Cincinnati, Ohio, Feb. 21.
Buildings, removing, Sim. Brown, N. Y., July 31.
Burning lime and bricks and boiling kettles, Sol. Hill, New Milford, Ct., Feb. 12.
Bush for millstones, Nat. Taylor, Urbana, N. Y., July 23.
Calicoes, etching steel mills for, D. H. Mason, Philada., Pa., Oct. 30.
Cane juice, clarifying, Wm. J. McIntoch, Georgia, March 7.
Card teeth, cutting, J. Lamb, Leicester, Mass., August 1.
Carding machine, Jno. Tilton, Newton, Conn., Sept. 8.
Carpeting, Jer. Bailey, Philadelphia, Pa., April 7.
Carriages, Theo. Brooks and D. W. Eames, Rutland, N. Y., Dec. 26.
Carriages, W. & J. Jessup, Guilford co., N. C., June 1.
Carts for removing earth, Jer. Price, Lockport, N. Y., May 18.
Cement, hydraulic, Ez. Guilford, Washington, D. C., Jan. 16.
Cement, imitation of marble, Ben. Trembly, N. Y., Nov. 13.
Cement, for roofs of houses, &c., Chs. Clinton, N. Y., July 13.
Chair, Edmund Daley, Baltimore, Md., Feb. 9.
Chair, repairing and finishing, Jacob Daley, Baltimore, Md., Feb. 22.
Cheese nets, L. M. Norton, Litchfield, Conn., June 4.
Chimneys, crank and wheel dampers for, J. Reilly and J. Flanagan, Waynesboro', Pa., March 10.
Chisel, bearded mortising machine, S. Metcalf, Wilmington, Vt., Jan. 17.
Churn, S. L. Bagley, Hillsdale, N. Y., March 24.
Churn, Levi Rosencrans, Urbana, N. Y., May 19.
Churn, E. Spain, Mount Holly, N. J., April 23.
Churn, D. Sheldon, Poultney, Vt., Sept. 13.
Churn, N. Whitney, Augusta, Me., May 7.
Churn, rocking, J. G. Phillip, Kinderhook, N. Y., Feb. 15.
Clock, wood wheel, 30 hours, H. G. Dyar, N. Y., Nov. 6.
Cloth sheering, J. Collins, Anson, Me., March 6.
Cloths, washing and scouring, J. Goulding, Dedham, Mass., July 12.
Cock for hydrants, valve, B. Stancliff, Philadelphia, Pa., May 15.
Combs, ornamenting, U. Bailey, West Newbury, Me., Nov. 15.
Combs, &c., rolling the backs of, N. Bishop, Danbury, Conn., Nov. 17.
Composition, marble, granite, &c., L. Mathey, Brooklyn, N. Y., Mch. 7.
Cooking apparatus, D. Westerfield, N. Y. March 24.
Copperas, making, I. Tyson, Baltimore, Md., Feb. 15.
Cordage, by machinery, R. Graves, Brooklyn, N. Y., July 25.
Cork cutter, Luther Hills, Boston, Mass., June 18.
Cork cutting machine, Geo. Rawlings, Philadelphia, Pa., Oct. 30.
Corn crusher, S. H. Gannett, Greenville, Tenn., May 25.
Corn sheller, Thomas Newman, Guilford co., N. C., Feb. 7.
Corn sheller, longitudinal, G. E. Waring, Poundbridge, N. Y., Mch. 16.
Cotton bagging, spinning, J. C. Dewees, Mason co., Ky., Dec. 28.
Cotton, cleaning Sea Island, Jesse Reed, Marshfield, Mass., Aug. 10.
Cotton, packing, Wm. Thomas, Richmond co., N. C., Feb. 15.
Cotton and hay press, T. D. Wilson, Corydon, Ind., June 6.
Cotton press, R. Jernigan, Waynesburg, N. C., May 15.

Cotton press, P. White, Chatham co., N. C., Feb. 19.
Cotton roving, Gilbert Brewster, Poughkeepsie, N. Y., March 28.
Cotton spindle, B. Brundred, Oldham, N. Y., July 14.
Culinary fixtures for anthracite, J. F. Walters, Philada., Pa., June 8.
Cutter, cant twist blade for, C. C. K. Beach, Portland, Me., Nov. 10.
Cutting machine for metals, J. H. Hall, Harper's Ferry, March 7.
Dearborns, balance on, S. Blaisdell, Lancaster, Ohio, Oct. 10.
Distilling, J. M. Aiken, Philadelphia, Pa., August 30.
Distilling, Wm. Coke, Cabinpoint, Va., Oct. 30.
Distilling, J. Lusk, Butler co., Ohio, Dec. 22.
Distilling by escape steam, D. Embree, N. Richmond, Ohio, Dec. 3.
Distilling spirits, fermenting and, I. Belknap, Millersburg, Pa., July 20.
Dividing engine for scales, S. Hedge, Windsor, Vt., June 20.
Dyeing and polishing leather, S. Couillard, Boston, Mass., June 27.
Earth from canals, hauling, O. Phelps, Lansing, N. Y., July 16.
Engines, constructing, E. A. Lester, Boston, Mass., May 14.
Fanning mill, Enoch Walker, Springfield, Pa., Sep. 20.
Flax dressing, H. Schoonhoven, Poultney, N. Y., Dec. 11.
Flax thrashing and breaking, P. Barker, Worthington, Ohio, Aug. 20.
Frame chain, David Lesley, N. Y., Nov. 19.
Fur cutting machine, M. Petre, Womelsdoff, N. Y., Dec. 20.
Fur, separating hair from, John McDonald, N. Y., Sept. 11.
Gas and heated air in aid of the power, M. Ward, Baltimore, Md., May 15.
Gas light from cotton seed, D. Olmsted, New Haven, Conn., July 21.
Gases procured in charring wood, S. J. Jones, Philada., Pa., Jan. 17.
Gate for canals, safety, Van Dorn and J. Glenn, N. Y., May 14.
Glass, combination of moulds in forming, G. and P. C. Dummer and J. Maxwell, Jersey City, N. J., Oct. 16.
Glass, moulds for preparing, P. C. Dummer, Jersey City, N. J., Oct. 16.
Glass knobs dressed at one operation, J. Robinson, Pittsburg, Pa. Oct. 6.
Grain, cleaning, J. Tyler, Claremont, N. H., May 11.
Grist mill, W. Adams, Guilford, N. C., July 18.
Grist mill, A. Bencine, Caswell, N. C., Jan. 16.
Grist mill, Wm. Benbow, Guilford co., N. C., Jan. 19.
Grist mill, A. and J. Coe, Guilford co., N. C., July 21.
Grist mill, A. Delap and A. Eve, Guilford co., N. C., May 31.
Grist mill, Wm. W. Forward, Hartford, Conn., June 18.
Grist mill, T. Newman, Guilford co., N. C., Feb. 6.
Grist mill, B. Overman, Greenbury, N. C., Sept. 28.
Grist mill, J. Robinson, Buckskin Township, Ohio, Dec. 14.
Grist mill, R. S. Thomas, Rockingham, N. C., June 4.
Grist mill, Wm. A. Turner, Plymouth, N. C., June 27.
Grist mill, crusher and sheller, J. G. Morse, Randolph co., N. C., March 20.
Grist mill, improvement on Mendenhall's, S. Lawing and J. Monteith, Statesville, N. C., June 11.
Grist mill, sugarloaf and, S. and P. Moore, Mt. Tirzah, N. C., June 15.
Gun lock, S. Cromwell, Edgecomb, Me., Feb. 3.
Gun lock, percussion, M. Davis, Mayville, N. Y., July 10.

Gun lock, percussion, Wm. A. Hart, Fredonia, N. Y., Feb. 20.
Hammer, foot trip, E. Pierce and J. Hathaway, Poultney, Vt., Oct. 19.
Harrow teeth, Wm. McConaughey, New Garden, Pa., Feb. 16.
Hat bodies, setting up, J. Grant, Providence, R. I., April, 10.
Hats, gearing of cones for bowing, T. F. Mayhew, Boston, Mass., Aug. 22.
Hats, stiffening of waterproof, S. Hemstead, Jr., St. Charles co., Mo., May 26 and Oct. 26.
Hatters' cards, or jacks, making, J. C. Seely, Dutchess co., N. Y., March 15.
Heat, evolution and management of, E. Nott, Schenectady, N. Y., May 30.
Heaving down vessels, J. Crowninshield, Salem, Mass., Oct. 19.
Hides, protecting from moths, Saml. Storm, N. Y., Feb. 17.
Hoes by rolling cast steel, } Chy. Bulkley, Colchester, Conn., Jan. 10.
Hoes, of cast iron, }
Hoes, harrows and ploughs, J. Cheatham, Providence Inn, Va., July 31.
Hoes, pronged, Jos. Wilson, Marlborough, N. H., Sept. 20.
Hoes, &c., ploughing and weeding, Wm. Carmichael, Sand Lake, N. Y., July 28.
Hollow ware, wooden, E. Briggs, Perry, N. Y., July 30.
Homony mill, Robt. Campbell, Martinsburg, Va., April 9.
Hoop and sheet iron manufactory, J. H. Pierson, Ramapo Works, N. Y., Dec. 24.
Horse yoke, Ad. Allen, Troy, N. Y., June 29.
Horse and hay rake, Jer. Bailey, Philadelphia, Pa., Mch. 30.
Hubs, cast iron, Benj. Lyman, Manchester, Ct., Nov. 6.
Hydraulic elevator, D. Corey, N. Y., Aug. 31.
Hydraulic machine, Jac. Roup, Kenhawa, Va., Oct. 6.
Inlaying gold in tortoise shell, U. Bailey, West Newbury, Me., Feb. 23.
Iron, rolling, Ab. S. Valentine, Bellefonte, Pa., June 3.
Jointing boards, El. H. Clarke, Damascas, Pa., Jan. 31.
Lamp for boiling water, T. G. Fessenden, Boston, Mass., Jan. 31.
Lathe for turning, Wm. Patrick, Leverett, Mass., April 24.
Leather, making water-proof, D. Kiser, N. Y., Nov. 19.
Lever gained power, E. G. Fitch, Blakely, Ala., Oct. 5.
Lime kiln, Abel Jeanes, Mill Creek Hundred, Del., Feb. 15.
Liquors, testing strength of, Wm. Cornell, Brooklyn, N. Y., Aug. 20.
Locks, J. Brown and G. W. Robinson, Providence, R. I., Feb. 20.
Locks, percussion, M. Davis, Mayville, N. Y., July 10.
Locks, percussion, Wm. A. Hart, Fredonia, N. Y., Feb. 20.
Locks, percussion, Jos. Shattuck, Jefferson co., Ohio, Nov. 10.
Locks, percussion lever, J. Ambler, Jr., S. New Berlin, N. Y., Oct. 16.
Locks, percussion magazine, J. B. Lowry, Mayville, N. Y., Sept. 11.
Loom for figured goods, H. Baker, North Salem, Aug. 31.
Loom, power, Wm. B. Leonard, Fishkill, N. Y., May 23.
Marine railway, Jos. Webb, N. Y., May 14.
Marine railway, J. Wood and P. A. Sabalan, N. Y., Oct. 6.
Mill, horizontal, Jon. Reynold, Amenia, N. Y., March 15.
Moccasins, water-proof, John Syms, N. Y., Nov. 14.

Mortar machine and grinding apples, J. H. Sheeler and J. S. Wilbert, Chili, N. Y., June 12.
Mortising machine, A. Greenleaf and H. Amidon, Mexico, N. Y. Dec. 28.
Mortising machine, Simon Le Roy, Mexico, N. Y., July 10.
Mortising and tenoning timber, J. McClintic, Chambersburg, Pa., March 31.
Navigation, improvement in, John J. Giraud, Baltimore, Md., Jan. 31.
Oil from flaxseed, D. Dodge, Hamilton, Mass., May 14.
Ovens, heating rooms, &c., Mich. Porteaux, Richmond, Va., Jan. 17.
Paddles, folding boat, E. Jenks, Colebrook, Conn., June 13.
Paddles, water, John J. Giraud, Baltimore, Md., Sept. 18.
Paint mill, Allen Holcomb, Butternuts, N. Y., May 14.
Paint mill, horizontal cast iron, O. Packard, Wilmington, Vt., Feb. 12.
Paper finishing, Ira White, Newburg, Vt., Feb. 28.
Paper machine trimming, J. McClintic, Chambersburg, Pa., Mch. 31.
Pianos, horizontal, T. Loud, Jr., Philadelphia, Pa., May 15.
Pipes, tubes, &c., Jos. Putnam, Salem, Mass., Jan. 17.
Piston, rotative, J. M. Cooper, Guildhall, Vt., July 16.
Plane or jointer irons, Chas. E. West, Colchester, Conn., Jan. 10.
Plane stocks of cast iron, H. Knowles, Colchester, Conn., August 24.
Plane, turner, sliding, Jon. Sparrow, Portland, Me., Dec. 26.
Planing machine, Jos. Rechm, Savage Factory, Md., Nov. 1.
Plough, Wm. Beach, Philadelphia, Pa., June 27.
Plough, R. Rhodes, Charlottesville, Va., Feb. 20.
Plough, angular, John Lupton, Va., July 31.
Plough, bar share, Eli Pugh, Chathan co., Conn., Dec. 24.
Plough, cast iron, R. Sweenney, Warren co., Ohio, May 18.
Plough, for planting corn, B. Murphy, Union District, S. C., Dec. 31.
Plough, for planting corn, H. Russell, Litchfield, Me., Jan. 16.
Plough, right and left, Geo. Dolfer, Frederick Town, Md., Aug. 20.
Plough, twin, N. G. Cryer, Wentworth, N. C., March 24.
Polishing hard and soft substances, B. Green, Hartford, Vt. Mch. 27.
Power by certain fluids, M. J. Brunel, London, England, Mch. 30.
Preserving butter, eggs, &c., H. Edmonston, Pike Creek, Md., Apr. 26.
Printing press, S. J. Couillard, Boston, Mass., July 14.
Propelling boats, Elisha Fuller, Providence, R. I., March 2.
Propelling boats, &c., Elijah Bryan, N. Y., Dec. 22.
Propelling machinery by weights, C. Broyles, Tellico, Tenn., Oct. 19.
Propelling machinery of all kinds, Wm. Stanton, Centre Township, Pa., April 23.
Pump, for steam boilers, A. Judson, Sweden, N. Y., Feb. 24.
Pumping vessels by wind power, T. Brownell, N. Y., March 23.
Railway carriage, R. P. Morgan, Stockbridge, Mass., July 27.
Rake, hand hay, A. Foster, Auburn, N. Y., Dec. 9.
Rake, hay and grain, M. and S. Pennock, East Marlboro', Pa., Feb. 17.
Rake and hoe handles, turning, { W. Shepperdson, Hamilton, N. Y., J. C. Sperry, Camden, N. Y., Dec. 3.
Rake and hoe handles, turning, A. Sperry, Rotterdam, N. Y., Dec. 26.

Rake teeth, turning tenons for, J. W. Sweet and W. Stedman, Berkshire, Mass., March 5.
Rice cleaning and hulling, J. Campbell, Winsborough, S. C., May 3.
Rice and coffee cleaning, E. Welder, Jersey City, N. J., Nov. 6.
Rooms, warming, A. S. McAllister and J. Iggett, Salem, N. Y., Dec. 15.
Rope layer, *(jack and breast work,)* D. Myerle, Philada., Pa., Mch. 3.
Sack shoulderer, L. Rice, Clarksborough, N. J., August 3.
Safety valve, chimney smoke, &c., J. H. Schreiner, Philadelphia, Pa., July 31.
Salt manufacture, B. Byington, Salina, N. Y., Feb. 21.
Saw mill, A. Bencine, Milton, N. C., June 4.
Saw mill, B. Overman, Greensbury, N. C., Dec. 11.
Saw mill, J. Spafford, Ipswich, Mass., June 23.
Saw mill, of Johnson's, A. B. Graham, Lee, Mass., Sept. 28.
Saw mill, reciprocating, Wm. Kendall, Waterville, Me., Dec. 31.
Saw mill, reciprocating, Wm. Kendall, Jr., Waterville, Me. Nov. 23.
Saw sett, spring, J. Baggs, Philadelphia, Pa., Oct. 4.
Saw, two edged, M. Cass and A. Bull, Caroline, N. Y., August 31.
Scagliola, shining, S. Pinistre, N. Y., June 18.
Scurvy, preventive from, J. M. Armour, Frederick Town, Md., Sept. 28.
Sheaves for shipping, cast iron, F. Seymour, Plymouth, Mass., Dec. 29.
Shingle machine, J. Daley, Baltimore, Md., Sept. 27.
Shingle machine, G. W. Dana, Rutland, Vt., Sept. 20.
Shingle machine, improvement on Hawes', G. A. Hoard, Antwerp, N. Y., Sept. 30.
Shingle, manufacturing, P. Hawes, Lockport, N. Y., March 30.
Shingle, manufacturing, O. Wheeler, Rochester, N. Y., Nov. 10.
Shingle, sawing machine, N. Swift, Lebanon, Conn., April 27.
Shovels, making, O. Ames, Easton, Mass., March 5.
Shuttle, mode of throwing, J. Goulding, Dedham, Mass., August 24.
Sleigh shoes, cast iron, E. Trask, Saugerties, N. Y., Oct. 6.
Sofa bedstead, J. R. Penniman, Boston, Mass., August 22.
Spectacles and single eye glasses, S. Newton, Washington, D.C., Dec. 22.
Spindles, preventing friction on, J. G. Sholtz, Rockaway Township, Ohio, July 6.
Spinner, Brown's vertical, H. Wilson, Pomfield, N. Y., July 13.
Spinner, family, Wm. Jones, Thornville, Ohio, July 27.
Spinner, for wool, B. Lapham, Queensbury, N. Y., June 29.
Spinning machine, N. Remington, Geneva, N. Y., April 21.
Spinning wool and cotton, W. Church, Birmingham, Eng., July 11.
Spur for bevel gearing, C. Neer, Waterford, N. Y., March 9.
Staves, preparing for truss hoop, A. Amsden, Bloomfield, N. Y., July 27.
Steam and rotary wheel, F. Harris, Albany, N. Y., July 10.
Steam engine, J. Maynard, Ovid, N. Y., June 15.
Steam engine, W. P. Wing, Newburg, Vt., August 17.
Steam, generating, L. Silliman, Albany, N. Y., Jan. 19.
Steam, heating by escape, A. Brown, N. Y., Oct. 30.
Steelyards, lever power, S. Andrews, Bridgetown, Me., March 24.

Still, M. McGregor, N. Y., June 15.
Stone, dressing, drilling and cutting, H. Bourne, Salem, Mass., Aug. 3.
Stone, hewing and hammering, C. B. Reed, West Bridgewater, Mass., June 27.
Stove, air funnel, H. Wales, Randolph, Mass., May 18.
Stove, cast iron foot, G. W. Robinson, N. Y., June 2.
Straw cutter, T. Benbow, Guilford, N. C., Feb. 16.
Straw cutter, L. Durham and J. H. Pleasants, Halifax co., Va., July 27.
Straw cutter and corn sheller, C. Chamberlain, Amenia, N. Y., Mch. 15.
Stumps, machine for raising, A. Pratt, Jackson, N. Y., August 17.
Suspenders, E. Chesterman, N. Y., June 19.
Suspenders, A. L. Van Horn, Philadelphia, Pa., Feb. 22.
Tailor's square, J. G. Wilson, N. Y., Feb. 23.
Tanning, O. Cogswell, Cincinnati, Ohio, Sept. 18.
Team scraper or shovel, G. Davis and J. Price, Lockport, N. Y., May 12.
Teeth, engrafting, E. A. Bigelow, Brandon, Vt., March 8.
Templets, spring, A. Jenks, and J. Clewell, Holmsburg, Pa., Mch. 19.
Thrashing machine, E. B. Pike, Litchfield, Me., Oct. 5.
Thrashing machine, vibrating, M. Pennock, Kennett's Square, Pa., May 26.
Thrashing, winnowing and flax breaking machine, E. Warren, N. Y., August 11.
Tide mill, R. Spedden, Talbot, Md., August 1.
Tire, bending, W. James, Ashford, Conn., July 14.
Tobacco, manufacturing, J. Ambler, Jr., Richmond, Va., April 3.
Tread wheel, C. Watson, Addison township, Ohio, Dec. 22.
Tubs of clay, machine for making, J. H. Rowen and H. Wise, Fredericktown, Pa., May 10.
Tubs, making wood sides of, J. Bailey, Philadelphia, Pa., April 7.
Type caster, mechanical, J. Sturdevant, and E. Starr, Boston, Mass., Oct. 23.
Vessels, raising by cradle screw, C. Miner, Lynn, Ct., Oct. 12 & Nov. 16.
Vessels, slinging yards of, I. Carver, Jr., Prospect, Me., Dec. 11.
Vests, spring stiffener for, J. D. Shute, Boston, Mass., Dec. 5.
Victualler, B. C. Burdett, N. Y., August 4.
Washing clothes and shelling corn, B. Rice, Denmark, N. Y., Nov. 23.
Washing machine, D. Beard, Buffalo, N. Y., June, 27.
Washing machine, M. Cass, Caroline, N. Y., July 29.
Washing machine, F. Kelsey, Middletown, Conn., Sept. 28.
Washing machine, C. Stone, Middleburg, Conn., Feb. 17,
Watch keys, J. S. Davis, Providence, R. I., April 3.
Watch seals, S. Davis, P. Babbett and H. P. Grunnell, Providence, R. I., March 3.
Water gate for penstocks or flumes, H. Potes, Christianburg, Va., Jan. 9.
Water gate, opening and shutting, O. Packard, Wilmington, Vt., Feb. 12.
Water power, apparatus to wheels, R. and T. McCulloch, Albemarle co., Va., May 26.
Water raised by revolving wheel, H. Miller, Allentown, Pa., July 28.

Water raised by steam power, G. Fleming, Goochland, Va., Apr. 24.
Water wheel, J. D. Wilcox, Corydon, Ind., June 7.
Water wheel for saw mill, T. Shute, Tenn., March 6.
Water wheel for saw and grist mills, J. Dennison, Lancer Township, Ohio, August 22.
Water wheel for steamboats, R. L. Stephens, Hoboken, N. J., Apr. 10.
Water wheel, letting water on, J. Ammon, Rockingham, Va., June 8.
Water wheel, letting water on, M. Hilderbrand, McMinn co., Tenn., Nov. 10.
Water wheel, screw, E. Skinner, Sandwich, N. H., Sept. 11.
Wheels, float, Stacy Costill, Philadelphia, Pa., Oct. 17.
Wheelwrights' assistant, C. W. Beach, Scoharie, N. Y., March 16.
Wheelwrights' assistant, J. Sitton, Pendleton, S. C., Feb. 15.
Wind mill, horizontal, T. P. Jones, Newcastle, Del. Feb. 16.
Wool, improvement in composition to start the oil in, J. Goulding, Dedham, Mass., August 24.

Wool, manufacturing, April 27. Wool, manufacturing, &c., July 10. Wool, manufacturing, August 24. Wool, &c., manufacturing, Dec. 15.	} J. Goulding, Dedham, Mass.

METEOROLOGICAL OBSERVATIONS FOR FEBRUARY, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	32°	41°	30.00	30.10	W.	Brisk		Clear.	Clear.
☽	2	23	47	30.25	30.20	SW.	Moderate		Clear.	Clear.
	3	54	62	30.18	29.74	SW.	do	.64	Rain.	Rain.
	4	62	65	29.60	29.60	SW. W.	do	.10	Cloudy.	Cloudy.
	5	44	46	29.40	29.70	W.	Blust'ring		Flying cl'ds.	Flying clouds.
	6	31	53	30.10	29.15	W.	Brisk.		Clear.	Clear.
	7	42	45	29.70	29.60	SW.	Moderate	.25	Cloudy.	Rain.
	8	31	35	29 54	29.53	W.	Brisk.		Par. Cloudy.	Partially cloudy.
	9	14	26	30.10	30.10	W.	Moderate		Clear.	Clear.
⊗	10	27	49	29.94	30.00	W. S.	do		Clear.	Clear.
	11	34	54	30.10	30.10	S. SW.	Calm		Cloudy.	Lightly cloudy.
	12	44	54	29.80	30.85	W.	do	.04	Rain.	Cloudy.
	13	37	40	29.84	29.73	E.	do	.43	Rain.	Rain.
	14	44	45	29.60	29.55	W.	Blust'ring		Cloudy.	Cloudy.
	15	20	30	30.10	30 15	NW.	Moderate		Clear.	Clear.
	16	32	44	29.70	29.20	E.	do	.85	Snow.	Rain.
	17	14	20	29.45	30.16	W.	Blust'ring		Clear.	Clear.
☾	18	20	42	30.20	30.10	SE.	Moderate		Lightly cl'dy	Lightly cloudy.
	19	50	46	29.50	29.60	W.	Blust'ring		Rain.	Flying clouds.
	20	21	29	30.36	30.30	NW.	Moderate		Clear.	Lightly cloudy.
	21	21	38	30.10	30.10	W.	do		Clear.	Clear.
	22	24	38	29.93	29 93	E. W.	do		Cloudy.	Clear.
	23	25	37	30.05	30.10	W.	do		Clear.	Clear.
☺	24	28	47	30.04	30.04	SW.	Calm.		Clear.	Hazy.
	25	34	41	30.24	29.37	E.	Moderate		Hazy.	Cloudy.
	26	36	39	29.60	30.00	E. W.	do		Drizzle.	Rain.
	27	36	48	29.80	29.84	W.	do		Cloudy.	Flying Clouds.
	28	36	50	30.00	30.00	W.	do		Por. Cloudy.	Clear.
		32.71	43.25	29.90	29.89			2.31		

Thermometer.		Barometer.	
Maximum 66.00 on 4th. Minimum 14.00 on 9th and 17th.	} Mean, 37.98.	Max. 30.85 on 12th. Min. 29.15 on 6th.	} Mean 29.895

		ometer						Hygrometer.				
		Colu ol va	Maximum.	West.	W. N. W.	N. W.		Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
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			.3	[illegible]	[illegible]	7		.	.....	....	..	[illegible]
			.[illegible]	3[illegible]	.	[illegible]		.	.....	....	..	1650
			.3	9[illegible]	.	6		.	.....	....	..	1623
			.[illegible]	[illegible]	.	2[illegible]		.	.....	....	..	1598
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			.[illegible]	1[illegible]	.	[illegible]		1	.....	66.72	1	1595
			[illegible]	6[illegible]	.	3[illegible]		.	.....	....	..	1560
			[illegible]	4[illegible]	.	[illegible]		.	.....	66.10	..	[illegible]
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31	H											
32	C	29		18[illegible]	.	.		.	.....	....	..	1601
33	P	29	[illegible]	1	1[illegible]	[illegible]		.	.....	....	..	1596
34	M											
35	Ch											
36	C											
37	B	28		6[illegible]	.	3		.	.....	....	..	1594
38	S	29	2	2[illegible]	8	2		.	.....	....	..	1584
39	In	28	[illegible]	3[illegible]	1	[illegible]		.	.....	67.64	12	[illegible]
40	Je											
41	W	29,		.	.	.		.	.....	....	..	1625
42	V											
43	A	29		.	.	19[illegible]		.	.....	....	..	1597
44	W											
45	P											
46	G	29.		4[illegible]	.	2[illegible]		.	.....	....	..	1608
47	W											
48	A											
49	B	29		[illegible]	.	4[illegible]		.	.....	....	..	1593
50	B											
51	M	29		[illegible]	.	1[illegible]		.	.....	....	..	[illegible]
52	C											
53	E	29	[illegible]	1	.	1[illegible]		.	.....	....	..	1591

JOURNAL

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AND

MECHANICS' REGISTER.

MAY, 1842.

Civil Engineering.

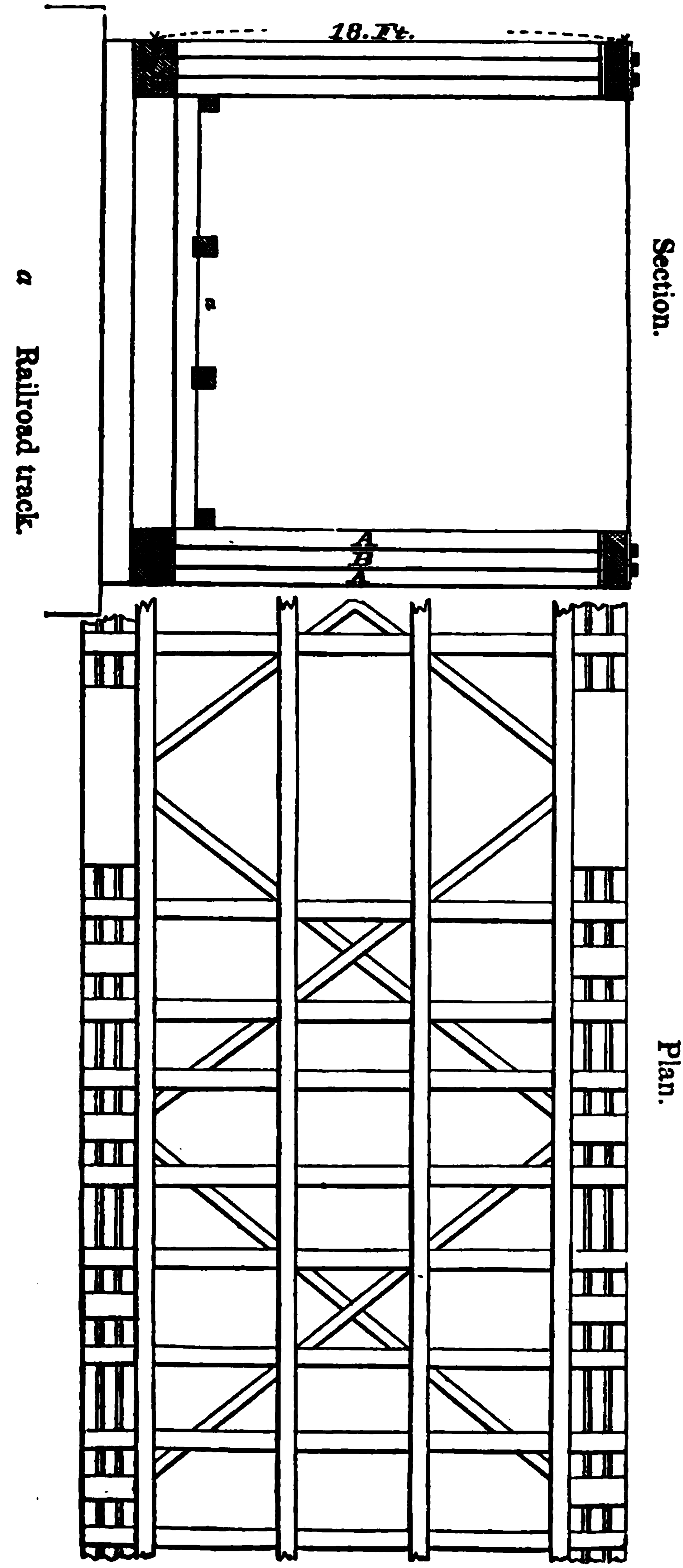
FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

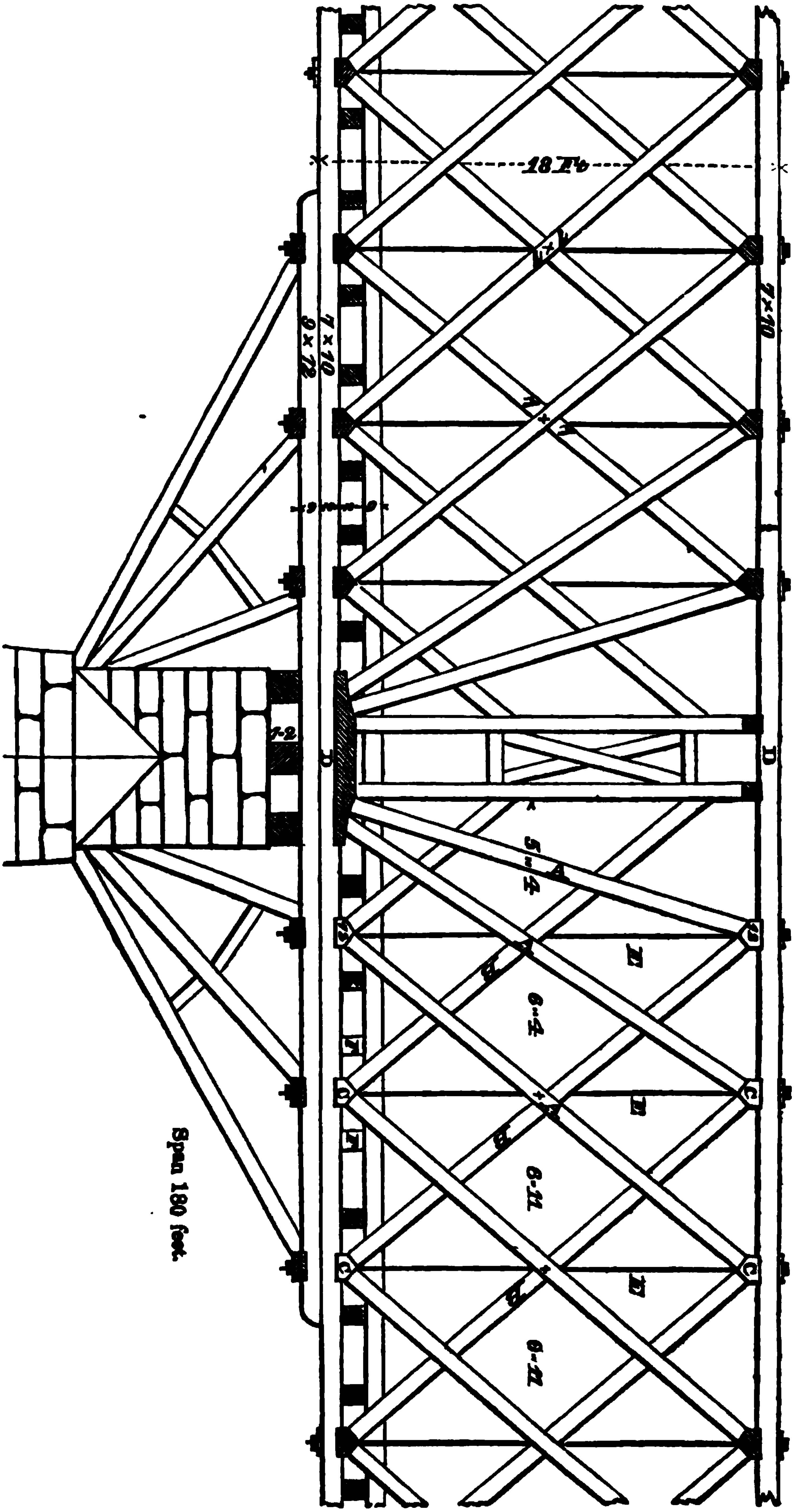
Description of Howe's Patent Truss Bridge, carrying the Western Railroad over the Connecticut River at Springfield, Massachusetts. By* LEWIS M. PREVOST, JR., *C. E.*

The accompanying drawing is a representation of the bridge built across the Connecticut river at Springfield, Massachusetts, on the line of the Western railroad.

Each truss is formed of a system of *main braces,* A, A, A, seven inches square, of white pine, inclined from the piers towards the centre of the span, abutting upon *white oak shoulders,* C, C, C, which are let into the *chords* D, D, to a depth of two inches; and *counter braces* B, B, B, of the same dimensions, inclined in the contrary direction, passing between each pair of *main braces* and also abutting upon the *white oak shoulders.* The upper and lower *chords* are composed of planks, forming, in all, six horizontal beams of seven by ten inches each. The whole truss is firmly bound together by the *iron rods* E, E, E, two inches in diameter, passing between the *main* and *counter* braces, and through the *white oak shoulders;* having screws cut on their lower ends, and the lengths adjusted by means of burrs; these suspending rods act in lieu of the king and queen posts usually employed, and sustain the lower chords, on which the girders, F, repose. The spans are 180 feet each, and the deflection of the bridge in the middle of a span, during the passage of a locomotive and train, by careful measurement, was found to be *only a quarter of an inch!*

* See the number of this Journal for October, 1841, page 250, where a brief abstract of the patent is given.


18. Ft.
A
B
A
a
a
Railroad track.
Section.
Plan.



Elevation.

Span 180 feet.

Some of the principal advantages of this plan are, that the stress comes upon the end grain of the *main* and *counter braces*, and is in the direction of their length—consequently there is not the same danger of the settling which occurs in lattice bridges, in consequence of the crushing of the pins and the splitting of the lattices at the ends—and there being a free circulation of air between the *main* and *counter braces*, the bridge is not so liable to the speedy decay which occurs in lattice bridges, wherever the lattices come in contact. There is also less timber required in Howe's truss than in Town's.

For a bridge of 180 feet span, there are in Howe's truss frames, 28,636 feet board measure.

For a bridge of 180 feet span, there are in Town's double lattice, 46,080 feet board measure.

These quantities of timber have been calculated for the trusses, or sustaining parts only, of the two plans respectively; supposing each to span 180 feet, and the truss depth of the former to be eighteen feet, whilst that of the latter was assumed at nineteen feet eight inches, both measured from the top of the upper to the bottom of the lower chord: the roof and floor would of course contain the same quantity of timber in both cases, and has therefore not been included, being evidently unnecessary in a *mere comparative estimate of the amount of lumber in each;* we must, however, observe that the above described trusses upon Howe's plan, contain the subjoined quantity of iron,—a material not used in the lattice bridges—viz:

Approximate weight of iron in the suspending rods and burrs of the two trusses of one of Howe's bridges, of 180 feet span,	21,100 lbs.
Approximate weight of iron in the transverse top ties,	710
Total,	21,810

Or nearly, *nine and three-quarter tons of wrought iron.*

The usual cost of the superstructure of covered railroad bridges, upon the plan above described, with long spans, and for a single track railway, inclusive of all materials, and of the workmanship, is about $ 22 per lineal foot of floor.

In conclusion, the writer will add his conviction, that in bridges with spans equal to, or exceeding, those of the bridge at Springfield, the peculiar truss above described, will be found superior in strength, stiffness, and durability, to those of Town's double lattice plan.

Philadelphia, April 6th, 1842.

Use of Bituminous Cements in Europe, and in the United States.

Some time since, a document came to the Institute, under the frank of the Department of War, and for which we presume, we are indebted to the kindness of Col. Totten, Chief of the U. S. Engineers.

This document is entitled "Papers on practical Engineering, published by the Engineer Department, for the use of the officers of the United States corps of Engineers," and consists of a valuable essay on "Bitumen, its varieties, properties, and uses. Compiled from various sources by Lieut. H. W. Halleck, U. S. Engineer, under the direction of Col. J. S. Totten, Chief Engineer."

We extract from this essay the last chapter, (XII) which exhibits in an abbreviated form, some of the most important results of the experience which has now been had in the use of Bituminous mastics, both in Europe and in this country; it was our first design to have given a synopsis of the entire document, but on perusing it, we found that the chapter referred to, contained such a summary of the practice detailed in the body of the work, as in a great degree to supersede the necessity of any other condensation of the subject matter.

To this extract we shall subjoin some remarks upon Coyle's resinous cement, its properties, and cost, as developed in an experiment, made with it on a tolerably large scale, in forming a floor over the arch of the Licking Aqueduct on the Chesapeake and Ohio Canal, to prevent filtrations.

This cement, which is a factitious mastic, having for its basis the common rosin of commerce,—was here applied by Mr. Coyle, the patentee,* in person, under the general supervision of one of the Collaborators for the Engineering department of this Journal.

Extract from "Papers on Practical Engineering," published by the United States Engineer Department.

Cost, specific gravity, proportions of ingredients, &c., of the Mastic used upon several Bituminous Works in Europe.

The proportions of the ingredients for bituminous mastic, as recommended by the authorities referred to in the preceding pages, are very far from being uniform. And this want of uniformity is not altogether

* The *exclusive* right of Mr. Coyle, to apply the resinous cement, in such situations as this, would certainly never stand the test of a forensic discussion; as may be inferred by examining an extract from his patent, in the number of this Journal for June, 1838, where the claim is expressly stated to be, "*the applying it* (in places, or vessels, *which contain water*) so highly heated as that it shall expel the moisture therefrom, so as effectually to adhere to pebbles, stones, wood, and other substances, with which it comes into contact."

Now as the Aqueduct referred to, did not *contain water* at the time of the application of the cement, it was not a case within the purview of Coyle's patent; neither was the use which was made of it at the Treasury building, as mentioned in the latter part of our extract.

due to the difference in the quality of the bitumens used, for the proportions are made to vary considerably, by different persons, where precisely the same materials are employed. Further experiments and analyses are necessary to form definite rules. And we can see no reason why rules may not be as readily determined for the mastics, as for the mortars and hydraulic cements, provided we resort to a chemical analysis of the materials, and a strict examination of the strength, hardness, elasticity, specific gravity, &c., of the resulting mastics. We here give a summary of the proportions of ingredients, cost of labor, and other data from several bituminous works, in hopes that they may serve as a basis for further investigations. The following analyses of several of the bituminous minerals, by M. P. Berthier,* may also be of use in comparing the results obtained from different mastics. It was noticed too late to be inserted in a more appropriate place.

Bitumen of Seyssel.—Of the bituminous minerals of Seyssel, there are three kinds. 1. A sandy mineral. 2. A very fusible calcareous mineral. 3. A calcareous mineral of difficult fusion.

The first of these melts in boiling water, and becomes detached from the stony matters to which it was adherent. It rises to the surface, or sticks to the sides of the vessel in brown lumps, or forms a transparent coating of a brownish red color. A rich specimen of it gave—

Bituminous oil, - - -	.086	Bitumen, .106
Carbon, - - - - -	.020	
Quartzy grains, - - -	.690	
Calcareous grains, - - -	.204	
	1.000	

In the mass it is much less rich. When purified by hot water, this bitumen is called *la graisse.*

The second variety is at Seyssel called *asphaltum.* It may be pulverized and sifted, but the powder spontaneously forms into balls. The specimen analyzed contained .11 of bitumen, 5.89 of carbonate of lime, without clay, and quite pure. The mastic of Seyssel is prepared by mixing nine parts of this asphaltum with one of the mineral tar (*la graisse*) extracted from the sand.

The third variety is a compact limestone, in extremely thin, parallel beds. It consists of—

Bituminous matter, - - -	.100
Argile, - - - - - - -	.020
Sulphate of lime, - - -	.012
Carbonate of lime, - - - -	.868
	1.000

Bitumen of Belley.—This bituminous mineral is very similar to the preceding. It is found in several communes in very considerable quantities, near the surface of the ground. It is of a variable quality. A specimen yielded—

* Annales des Mines, tom. 13, liv. 3.

Carbonate of lime, - - - - -	.824
Carbonate of Magnesia, - -	.020
Sulphate of lime, - - - - -	.013
Argile, - - - - - - -	.023
Bitumen, - - - - - -	.120
	1.000

Bitumen of Bastenne.—This bitumen flows out from several openings, or springs, mixed with water. An analysis of the solid variety gave:—

Oily matter, - - - - -	.200	Bitumen, .237
Carbon, - - - - -	.037	
Fine quartzy sand, mixed with argile,	.763	
	1.000	

Bitumen of Cuba.—This is transported to Europe under the name of Mexican asphalt, or chapopote. It is a solid bitumen, which exists in abundance near Havana. It may be used with great advantage in paving. It consists of at least two different substances, the one soluble and the other insoluble in ether and the spirits of turpentine. It is the relative proportion of these two substances which imparts to the different bitumens their peculiar properties.

Bitumen of Monastier. (Haute Loire.)—This does not soften in the least in boiling water, and hence cannot be extracted, by any simple means, in large quantities. It contains—

Bituminous oil, - - - -	.070	Bitumen, .105
Carbon, - - - - -	.035	
Water, - - - - -	.045	
Gas and vapors, - - - -	.040	
Quartz and mica, - - -	.600	
Ferruginous argile, - - -	.210	
	1.000	

The bitumen of Haute Loire differs essentially from those of Seyssel and Bastenne, by its insolubility in boiling water, and its solubility in alcohol.

The following is the quantity of material per square yard of bituminous covering, as given in the "Manuel pour l'Application de l'Asphalte du Val-de-Travers."

For one square yard of bituminous mastic paving, at a thickness of $\frac{48}{100}$ of an inch, there will be required—

33.10 pounds of the asphaltic mastic.
18.39 pounds of fine gravel.
0.62 pounds of mineral tar.

Or the following proportions may be used:—

36.78 pounds of the asphaltic stone.
2.84 pounds of mineral tar.
18.39 pounds of fine gravel.

For one square yard of ordinary bituminous covering, at a thickness of $\frac{4}{10}$ of an inch, there will be required—

40.46 pounds of pure mastic.

For one square yard of stable paving of the bituminous mastic, at a thickness of $\frac{72}{100}$ of an inch, there will be required—

From 40.46 to 44.14 lbs. of the asphaltic stone.
36.78 pounds of gravel.
2.68 pounds of mineral tar.

Specific gravity of the mastic made from the asphaltic stone of the Val-de-Travers—

One cubic foot weighs, - - -	140.99 lbs.
One square yard, $\frac{4}{10}$ of an inch thick, -	41.62 "
One square foot, $\frac{1}{12}$ of an inch thick, -	1.10 "

The specific gravity of the mastic of Parc, is 140.72 pounds, per cubic foot, which differs but very little from the preceding.

This last mastic, at the manufactories, costs, $2.25 per 100 lbs.

A covering of this mastic, $\frac{4}{10}$ of an inch thick, costs $1.01 per square yard.

The weight of the different kinds of asphaltic coverings recommended in the manual of the Seyssel Company, is as follows:—

First: A square yard of the bituminous covering applied upon cloth, the surface being first spread over with gravel, and the whole resting on a bed of mortar of a mean thickness of one and a half inches:—

For the mastic, - - - - - -	45.9 lbs.
" " bed, - - - - - - - -	110.3 "
Total,	156.2 "

Second: The mastic, cloth, and gravel, for one sq. yd.,	45.9 lbs.
The tile, 1 $\frac{2}{10}$ inches thick, the mortar included,	73.6 "
Total,	119.5 "

Third: The mastic, cloth, and gravel, per square yard,	45.9 lbs.
The tile, $\frac{8}{10}$ of an inch thick, laid dry,	55.1 "
Total,	101.0 "

Fourth: The mastic, cloth, and gravel, per square yard,	45.9 lbs.
The tile, 1 $\frac{2}{10}$ inches thick,	82.7 "
Total,	128.6 "

Fifth: The mastic, cloth, and gravel, per square yard,	44.1 lbs.
The tarred paper,	3.6 "
Total,	47.7 "

The manual of the Val-de-Travers Company gives four and a half or five per cent. as the proportion of mineral tar to be used for flag-

ging sidewalks, vestibules, &c.; and seven and a half or eight per cent. for paving stables, courts, and works of that character. If the mastic be used for stables, the gravel should be full one half the whole mass. Mixture given for McAdamized roads, one-third coal tar, one-third pulverized asphaltic stone, and one-third fine sand. For pointing wooden pavements, the mastic is composed of eighty-five or ninety parts of asphaltic stone, five of mineral tar, and five or ten of fine sand.

Captain André used, at New Brisack, for covering the planking of a draw-bridge, one part by weight, of Lobsann mastic, and seven parts by weight of mineral tar. Cost of this covering per square yard, $0.12.

Another mixture used for the same purpose, one part of Lobsann mastic, one and a half part of mineral tar. Cost per square yard $0.14.

Captain Chauvet used for pointing masonry at New Brisack a mixture of ten parts of Lobsann mastic, and nearly one part of mineral tar. The joints were $4\frac{72}{100}$ inches deep, and one-fifth of an inch wide. Cost of this pointing per foot running measure, $0.3¾.

Major Tomassin used for pointing masonry, at New Brisack, six parts of Lobsann mastic to one part of mineral tar. The joints were but $\frac{59}{100}$ of an inch deep, and $\frac{74}{100}$ of an inch wide. Cost of this pointing, per foot, $18\frac{7}{100}$ cents.

For pointing and rough casting masonry at Schelestadt, Captain Duché used thirty parts of Lobsann mastic to one part of mineral tar. Cost of this, per square yard, $0.77.

The same officer at Strasbourg, and for the same purpose, used two parts of Lobsann mastic, and one part of mineral tar.

For coating masonry, at Valenciennes, M. Huz used a mixture of—

220 pounds of bituminous mastic,
110 " of linseed oil,
6½ " of litharge,
26½ " of spirits of turpentine, and
6 cakes of Spanish white.

Cost of a covering of this mixture, per square yard, $0.12.

M. le Blanc gives the following proportions for an artificial bituminous mastic:—

18 parts of pitch *(brai sec,)*
18 " mineral tar,
6 " slacked lime,
60 " sand,
30 " fine gravel.

If chalk be used, the following are the proportions:—

1 part of mineral tar,
1 " pitch,
7 " chalk,
2 " sand,

The cost of a covering of M. le Blanc's artificial bituminous mastic, $\frac{6}{10}$ of an inch thick, per square yard, is—

For materials, about - - - - -	$0.12½
For workmanship, - - - - - - -	0.24
For fuel, utensils, &c., - - - - -	0.03½
Total cost,	$0.40

M. Partiot gives the first cost of the ordinary pavements of Paris, per square yard, $1.25.

First cost of bituminous pavements of Paris, per square yard, $1.42.

First cost of paving blocks, six inches thick, composed of fragments of stone and bituminous mastic, per square yard, $1.27.

First cost of a pavement of an artificial bituminous mastic, $\frac{6}{10}$ of an inch thick, built on a brick foundation laid in hydraulic mortar, per square yard, $1.01.

First cost of a natural bituminous pavement, of the same thickness, and of the same kind of foundation, $1.39.

First cost of granite paving, $3.32.

First cost of Lava paving $2\frac{4}{10}$ inches thick, $2.24.

The composition used in forming a floor in Assomption Barracks, Paris, for one square yard, half inch thick, was made of—

Sand, - - - - -	21.33	pounds.
Mastic, - - - - -	39.24	"
Mineral tar, - - - -	0.62	"

The composition used in covering casemates at Vincennes, for one square yard, half inch thick, was made of—

Sand, - - - - -	21.19	pounds.
Mastic, - - - - -	38.88	"
Mineral tar, - - - -	0.52	"

The amount of coal required as fuel, to prepare the mastic for covering one square yard, is estimated by M. Perrin, at 10.87 pounds, and the amount of labor $\frac{7}{100}$ of a day's work. He allows $\frac{1}{10}$ of the cost for the use of utensils, and profit of contractors.

The proportions given in the manual of the Seyssel company for forming a mastic to be used on the caps of arches are:—

Powdered asphaltic stone, - - - -	92 parts.
Mineral tar, - - - - - - - - -	8 "

If the mastic is to be used for roofs:—

Powdered asphaltic stone, - - - -	93 parts.
Mineral tar, - - - - - - - - -	7 "

If it is to be used for flagging:—

Powdered asphaltic stone, - - - -	60 parts.
Mineral tar, - - - - - - - - -	7 "
Gravel, - - - - - - - - -	33 "

The following table of prices of Seyssel mastic is published by "Coignet & Cie., Paris. Rue du Bac, 83:"—

Area of from—	Covering for Sidewalks.		Covering for Terraces.		Foundations.	
					Of Concrete.	Of Brick.
1 to 2 sq. yds.	$3.17	pr. sq. yd.	$3.49	pr. sq. yd.		
1 to 3 "	2.14	"	2.46	"		
3 to 4 "	1.90	"	2.38	"		
4 to 5 "	1.66	"	1.98	"		
5 to 6 "	1.58	"	1.90	"	$0.48	$0.55
6 to 7 "	1.50	"	1.82	"		
7 to 8 "	1.42	"	1.74	"		
8 to 9 "	1.34	"	1.66	"		
9 to 10 "	1.26	"	1.58	"		
10 to 50 "	1.18	"	1.50	"		
50 to 200 "	1.10	"	1.42	"	0.39	0.48
200 to 500 "	1.02	"	1.34	"		
500 and above	0.94	"	1.26	"	0.31	0.39
		At a thickness of 0.48 of an inch.		At a thickness of 0.40 of an inch.		

Pointing of flagging, $0.18 per linear yard.
"Solins," 0.21 " "

Asphaltic stone, eight and a half francs ($1.59,) per 100 kilm's. (220½ lbs.,) delivered at Marseilles.

Mineral tar, forty francs ($7.48,) per 100 kilm's. (220½ lbs.,) delivered at Marseilles.

Asphaltic mastic, fifteen francs ($2.80,) per 100 kilm's. (220½ lbs.,) delivered at Marseilles.

The following prices (from "Essay on Bitumen," London, 1839) for constructing bituminous pavements, &c., in London and the immediate vicinity, are those given in the advertisements of the Bastenne company, in the year 1839.

PRICES.*

First.—For the Materials.

Pure mineral tar, - - - -	$6.16	per cwt.
Mastic, - - - - - -	2.20	"

Second.—For the Construction of Works.

The Paving of Sidewalks.

From	50	to	100	square feet,	$0.27½	pr. sq. foot.
"	100	to	250	"	0.24	"
"	250	to	500	"	0.20	"
"	500	to	750	"	0.18	"
"	750	to	1000	"	0.16	"
"	1000	to	2000	"	0.14	"
"	2000	to	5000	"	0.12	"

* In changing the denomination of these prices from the English to our own coins, the shilling is taken at twenty-two cents, its usual current value in the United States.

Covering of Roofs and Terraces.

From	50 to	100	square feet,	$0.32	pr. sq. foot.
"	100 to	250	"	0.29	"
"	250 to	500	"	0.23	"
"	500 to	750	"	0.22	"
"	750 to	1000	"	0.20	"
"	1000 to	2000	"	0.18	"
"	2000 to	5000	"	0.16	"

Pointing.

For filling up joints of brick-work, &c., the price will vary from one and four-fifths cents to two and one-fifth cents per foot, running measure, according to the quantity of mastic used.

These prices are calculated for a thickness of half an inch.

The following from Silliman's Journal—(Vol. xxxiv, No. 2,) are the retail prices, as charged by the Seyssel Company in Paris, for furnishing the raw materials, or executing bituminous works:—

Asphaltic stone in its native state,	$2.08	per 100 lb.
For constructing foot pavements, &c., &c.,	1.28	per sq. yd.
For covering roofs, &c.,	1.65	"

From the same work we find the following prices: For Yorkshire stone paving, where small sized flagging stones were used—

	Tooled.	Rubbed.
For three inch paving, per square foot,	$0.16	$0.21
For four inch paving, per square foot,	0.22	0.26

Where larger stones are required, for the more traveled thoroughfares, the prices are as follows:—

	Tooled.	Rubbed.
For four inch stone, per square foot,	$0.36	$0.44
For five inch stone,	0.44	0.52
For six inch stone,	0.62	0.70

The "Civil Engineer's and Architect's Journal," page 419, gives the Belgium prices for making sidewalks of Lobsann mastic, as follows:—

Any area under 30 yards,	$1.02	per yd.	for plain work.
	1.09	"	lozenged.
Any other quantity,	0.95	"	for plain work.
	1.02	"	lozenged.

Use of Bituminous Mastic in the United States.

Although we have several varieties of bitumen in different parts of this country, and in some localities large quantities of it, but little attention has heretofore been given to its use; and even in the few instances in which it has been employed as a building material, no proper record of the details and results has been made or published. Considerable quantities of the foreign bitumens have been imported and used in our large cities for sidewalks, floors, roofs, &c., but they have sometimes failed to give satisfaction, through ignorance of the

proper mode of making and applying the mastic. Wherever the proper directions have been followed, the success has been complete. It is hoped that the experiments which are now being made upon our public works, will soon furnish some valuable facts to be added to the following scanty record.

Major John L. Smith, of the United States Corps of Engineers, procured for the public works in New York, in the fall of 1839—

Asphaltic stone at - - -	$1.13	per 100 lbs.
Bastenne tar, - - -	4.76	"
Use of kettles and other utensils, -	0.30	per day.
Services of an "applicateur," -	1.50	"

The same officer purchased in New York, from the agents of the Val-de-Travers Asphaltic Company—

Asphaltic stone at - - -	$1.20	per 100 lbs.
Bastenne tar, - - - -	5.25	"

In March, 1841, in consequence of the above company stopping operations,* Major Smith purchased of the agents in New York, Messrs. Thirion & Millard, their whole stock of Bastenne tar, consisting of twenty-nine casks, each containing about six hundred pounds, at the reduced price of $ 3.93 per one hundred pounds; and the requisite amount of asphaltic stone to be used with this tar in forming mastic, at $0.90 per one hundred pounds. The remainder of their stock of asphaltic stone, for which they had no mineral tar, was offered at $0.81 per hundred pounds.

The "applicateur" employed at Fort Schuyler recommended that the above materials be used in the proportion of *thirteen* pounds of the asphaltic stone to *one* pound of the mineral tar. In one of the experiments made at that fort, the mastic was formed of 11½ pounds of the stone to one of tar. These proportions differ but slightly from those given in the manual of the Val-de-Travers Company for making mastic of the same materials. The experiments of Major Smith were completely successful. The casemates that have been covered with the mastic remain perfectly water-tight, and to this date no alteration can be perceived in the material.

An analysis of the cost of this covering gives, for one square yard—

53.70 pounds bituminous stone, at 1¼ cents per pound,	$0.67.125
4.70 pounds Bastenne tar, at 5¼ cents per pound,	0.24.675
Labor, fuel, use of utensils, &c.,	0.19.230
Total cost per square yard,	$1.11.030

In a letter to Major Smith, dated New York, September 2d, 1840, Mr. John Barrell, agent for the London Bastenne Company, offered

* The report of the company stopping operations was communicated to the Engineer Department, in a letter of Major Smith to the Chief Engineer, dated New York, February 16th, 1841; but in a letter which has been received at this department, dated Paris, February 24th, 1841, "Aug'te Baboneau & Comp'ie, Proprietaires des Mines d'Asphalte, du Val-de-Travers, (Suisse,)" offer to supply, in New York, any amount of the mineral tar and asphaltic stone.

to furnish that mastic, properly prepared for laying, at about one and a half cents per pound, independent of freight.

In September, 1839, one hundred and twenty-six square yards of "asphalte" (bituminous mastic) was laid by Mr. Caylers, agent for the Val-de-Travers Company, upon the stone paving of the upper terre-plein of Castle Williams, New York, at $ 1.25 per square yard. Upon a recent examination of this covering, it was found to be soft and brittle, and had no adhesion to the paving stones.

In June, 1840, Mr. Lowitz offered to lay, in the public buildings at Washington, pavements of the natural asphaltic composition for twenty-five cents per square foot, or to make a pavement three-fourths of an inch thick, partly of "natural asphalte," and partly of an artificial mastic, ("mastic cement,") for twenty-two cents per square foot. The application of this mastic as a covering to the Exchange in New York, is said not to have succeeded well. The following proportions for the ingredients of this "mastic cement" of Mr. Lowitz, were furnished to the compiler by Mr. Mills, the architect of the public buildings in Washington:—

	100 lbs. of asphaltic stone,	No limestone being used.
	10 lbs. of mineral tar,	
	50 lbs. of sand,	
Total,	160 lbs.	

The following is the proportion of the ingredients taken for five hundred and fifty square feet of bituminous mastic laid down at White Hall, in London:—

0.25 ton of bituminous matter,
0.75 " limestone *(calcaire,)*
0.50 " gravel,

Total, 1.50 tons for an area of five hundred and fifty square feet, one half inch thick. From this it appears that one square foot of this paving requires one pound of the asphaltic stone, and about six pounds of limestone and gravel, making in all seven pounds. From these prices, Mr. Mills estimates the cost of the same mastic in Washington:—

One pound of the bituminous matter, duty free, - -	$ 0.05½
Six pounds of limestone and gravel, - - - - -	0.00½
Preparing and laying the mastic, - - - - - - -	0.05
Total cost per square foot, - - - - - - -	0.11
" " " yard, - - - - - - -	0.99

Mr. Mills also gives the cost of furnishing and laying a marble flagging in the public buildings in Washington, per square foot, $ 0.62½
Ditto of Seneca stone, - - - - - - - - - - 1.00
Ditto of German stone, - - - - - - - - - 0.37½

Mr. Saltonstall, agent of the Bastenne Company, proposed to pave, with that bituminous mastic, an area of twenty-three thousand feet, in the new Treasury and Patent Office buildings, at fifteen cents per square foot. The agent in Philadelphia, of the Seyssel Company, pro-

posed to execute the same work for twenty-five cents per square foot of covering, half an inch thick. No trials have, as yet, been made of either. Four hundred and seventy-two square feet of Lowitz mastic were laid down, about one year since, under the east steps of the Treasury building, which has stood perfectly well. A few feet were at the same time laid upon the lower terrace, where it is exposed to the heat of the summer's sun and the frost of winter; it also has undergone no change. A covering of Coyle's artificial resinous cement was also laid both without doors and within. In both cases it has already been cracked and otherwise injured by the frost.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Coyle's Resinous Cement above referred to. By ELLWOOD MORRIS, C. E., *one of the Collaborators for the department of Civil Engineering.*

This cement is *a resinous mastic,* consisting of various proportions of dry clay in powder, compounded with the common rosin of commerce, by melting the latter in a caldron; and stirring in the powdered clay, whilst the rosin is kept in a fluid state by heat.

In 1838, Thomas C. Coyle, the patentee of this mastic, which he called the *American Cement,* published a small pamphlet filled with favourable certificates, from gentlemen who had inspected his specimens; and to one of these, which he presented to the writer, was appended a printed sheet, giving directions concerning the manufacture and application of the cement; which we re-print, as being necessary to a full understanding of the subject.

Brief Directions for preparing the materials, and for making and applying the American Cement.

"Select a piece of ground composed of good brick, or potters', clay; remove the soil by means of a plough; plough up the clay, and harrow the same; toss and handle it until it is completely dry. The dried clay is now pulverized by passing through a cylindrical mill, made of wooden rollers, similar in construction to a rolling, or sugar-cane, mill, with this exception, that the rollers are placed alongside of each other, instead of one above the other. A hopper is placed above the rollers for the convenience of feeding the mill. Beneath these rollers is placed a *wire screen,* in an inclined position, and by means of a small crank gives it a quivering motion; the clay dust will thus deposite itself beneath the screen, while pieces of stone, &c. &c., will be carried off down the inclined screen.

"*For making the Cement.*—Take from one to ten iron kettles (as the job may warrant) containing from ninety to one hundred and twenty gallons each, walled up in the same way that hatters' kettles generally are, or let the kettles be cast, and each set in a furnace sufficiently large to receive fuel enough to boil the cement, and placed

* Mr. Mills' manuscript letter to the compiler, dated July, 1841.

upon truck wheels; this will be found very convenient in executing small jobs of work. Take rosin of a good quality, and put into each kettle a quantity so as to fill, when melted, about one-fourth of each kettle. When the rosin is completely melted, commence adding the pulverized clay in such quantities as can be promptly incorporated with the rosin; a great boiling, or effervescence, takes place at the union, and almost entirely ceases when the union is complete. A brisk fire should be kept up until the cement begins to emit bluish smoke, which is the surest test that all vegetable matter is boiled away, and the cement ready for application. During the whole time, the cement should be kept stirred by the following means: Let a stirrer be placed in each kettle, with arms crossing at right angles; between these arms let it be interwoven with hoop iron, and a crank attached to the stirrer.*

"*Application.*—The cement is removed from the kettles by means of iron dippers attached to handles four or five feet long, or let the kettles be cast with a tube to project about one foot, and of sufficient size to admit of the cement passing out into tubs, or buckets, and carried to the place of application. It would be utterly impossible to lay down any general rule for the application of the cement that would embrace a great many of the jobs; this must be regulated by the good sense of the practical mechanic, according to circumstances. The following, however, have the inventor's experience to test their utility. When a vessel, wall, or pier of any kind, is about to be formed, let a frame be made of stout planks the size of the vessel intended to be built. It is a general rule to cast the bottom of all vessels first, then start the frame for the upright walls; let the frame be well braced from each side, so that the pressure of the cement may not cause it to spring or warp, then pour in the cement in its fluid state till the space be filled. When the cement becomes hard, the frame can be taken away. To prevent the cement from adhering to the planks, let paper, or some other substance, be spread over the planks; by this means the frame can be removed with ease and despatch. In building the wall of a fort, lock of a canal, or any work of magnitude, either to keep water in or out, if the work is required to be exceedingly strong, pack your stones loosely; raise your wall—say three feet at a time; place at the distance of four or six feet apart, iron or wooden pipes; pour your cement through these pipes; by this process the cement passes through the interstices till it gains its level on the top, filling with accuracy every part. While the cement is yet hot, the pipes or tubes must be removed, and when the cement becomes hard, let the walls be continued by the same process until they are raised to the extent required. This process could be proved on a small scale to the satisfaction of the most sceptical, by filling a barrel, or any other vessel, with stones, and grouting the same with the cement, then breaking the mass into fragments. It will bear sufficient testimony to the mind of what can be done on a larger scale."

* The kettles can be worked by manual labor or horse power, according to the magnitude of the job.

Mr. Coyle's patent bears the date of August 18, 1837; and the claim in substance is for *the application* of this mastic, "*in places or vessels which contain water.*" The composition itself was not claimed, having been long known, though but little used.

In the year 1838, a large body of this cement was applied to form a floor within the Licking Aqueduct of the Chesapeake and Ohio Canal; with the view of obviating those filtrations, which so commonly produce a dripping soffit, in the stone arches of canal aqueducts.

With regard to its use in this case, the following information was derived, by the writer, from personal inspection, and the official reports of his assistant in charge of the work.

The floor referred to, was formed by a mass three feet in depth, of angular fragments of limestone, of the size of a man's head, grouted full of the resinous cement, melted and poured in hot; side walls, several inches thick, were then formed of the cement alone, rising about a foot on each side, to cover the rubble work, and join the cut stone ashlar facing of the aqueduct trunk; and the expense of the whole, including Mr. Coyle's superintendence and all other charges, as stated in his bill, amounted to a little over $2,000.

The aqueduct arch has a span of ninety feet—the width of the trunk occupied by the rubble stone cemented floor, is $17\frac{95}{100}$ feet—the mean length of the same is $95\frac{4}{10}$ feet—and in consequence of the extrados of the arch occupying a small space, there were 152 perches of rubble stone used, each perch containing twenty-five cubic feet.

The total quantity of the resinous cement used at the aqueduct, was 2,720 bushels, of which 680 were manufactured in Baltimore, and brought to the work in fragments barreled up; the remaining 2,040 bushels were made on the margin of Licking creek, using the clay found on the left bank near the site of the aqueduct; the rosin alone for this portion was brought up from Baltimore, and the 2,040 bushels, consisted of 1,548 bushels of dry clay in powder, commingled with 492 bushels of rosin, or *three and one-seventh parts of clay by measure, to one part of rosin*—this was the general average, though in a great deal of it, the clay was incorporated with the rosin, in the proportion of *two and six-tenths part to one.*

The specific gravity of this mastic as made here was 1,886, and the weight of the cubic foot $117\frac{7}{8}$ lbs. Of the 2,040 bushels of cement manufactured at the aqueduct,

The actual cost—of digging, delivering, and preparing the clay—of the rosin delivered—and of the whole application of the cement—supposing the work prepared to receive it,—the kettles set up ready for use—and exclusive of any charges for superintendence, or for the use of the patent—was as follows:

164 barrels of rosin in Baltimore - -		at 125c	$ 205.00
164 do do transported to the work, over 62 miles of railroad, and 44 miles of turnpike, = 106 miles, aggregate haul,		at 168c	275.52
Labor.	141 days work of men,	at 131¼c	185.06
	16 do of carts,	at 156¼c	25.00
516 barrels of clay cost nothing,			0.00
Total *actual cost* of 680 barrels of mastic made,			$ 690.58

Each barrel contained three bushels—therefore the cost of a barrel of the cement as made here, was $\frac{\$ 690\frac{58}{100}}{680}$ or 102 cents per barrel; and the cost per bushel was 34 cents.

Being used without any admixture of sand, which enters so largely into, and so much reduces the expense of, common hydraulic mortars, this mastic is very costly in its application: thus to grout the 152 perches of rubble stone, *loosely placed*, required 1,300 bushels, or $8\frac{55}{100}$ bushels per perch, *costing*, (at the ascertained price of 34 cents per bushel,) $2.91 *per perch for the mastic alone.*

Some rough experiments which were made during the progress of this work, showed that Coyle's mastic contracted in cooling, about $\frac{1}{80}$th part of its bulk in the fluid state, and this aroused at the time, in the mind of the writer, strong doubts as to its resisting, with success, the changes of temperature incident to our climate; subsequent experience at this work and others, has shown that these doubts were well founded, and it may now be pronounced, that the dilatable and contractile properties of this cement, render it unfit for use in the open air, because it possesses but little ductility, and cracks to pieces under the effects of frost; another evidence of its deficient ductility, may be gathered from the fact that it admits, like stone, of being freely sledged into fragments: the writer also noticed that in hot weather—when the sun's rays reflected from the cut stone walls of the aqueduct trunk, rendered it an unusually warm position—prints of the footsteps of persons, passing over the mastic, remained upon its surface.

The patentee states in his pamphlet, in speaking of this cement, that "its imperviousness has been tested, by subjecting a plate of it, one-fourth of an inch thick, to the pressure of a column of water *twenty feet high*, without affecting it in the least." And the writer, from what he has seen, entertains no doubt that when in sufficient mass, and free from cracks, *it is* impenetrable to water; if then it were used in situations which admitted of its being protected from great atmospheric changes, by a covering of earth, or other means; it seems highly

probable that there are cases in construction, where it may be made very useful in preventing filtrations.

The cement under consideration is very adhesive both to stone and wood, if they are clean and free from dust, of which the interposition of but a small film appears to be sufficient to impair, very essentially, its adherent properties.

The writer having noticed that when the cement was brought from the caldrons and poured upon the cold rubble stone, it very quickly became viscid and ceased to run, conceived the idea that its penetration into a mass of fragments of stone would be very limited in depth; and upon mentioning this to Mr. Coyle, that gentleman (with a readiness to make experiments to satisfy objections, which always distinguished him,) immediately caused a hogshead, four feet in height, to be filled with stone, and then grouted up with the resinous cement; at a subsequent period the hoops were knocked off, and the staves being removed, the cemented mass was sledged up, (splitting indifferently through both stone and cement, like a homogeneous body,) and it showed *no cavities in any part:* this was accounted for by the fact that the body of stone was comparatively small and easily heated up—the shape of the vessel favorable to the retention of heat—and the material composing it a non-conductor; the writer then took up and examined a portion of the rubble stone floor which had been apparently grouted full—but numerous cavities were found at the depth of a foot and a half; which induced the subsequent carrying on of this work, *in layers of one foot deep.*

The net actual cost of the "American Cement" (clear of all profit) *being $ 2.91 per perch of 25 cubic feet of wall,* or nearly treble that of the calcareous cements generally used in hydraulic works, it is not at all likely that this mastic will supersede them in ordinary constructions, though situations will occasionally occur where it may be used with propriety, if the cost of the Bituminous mastics, or other circumstances, should prevent recourse being had to them.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Injudicious Policy pursued in the Construction and Machinery of many Railroads in the United States. By John C. Trautwine, *Civil Engineer.*

I have read, with much pleasure, an able pamphlet, entitled "*The causes which have conduced to the failure of many Railroads in the United States,*" written by Mr. Charles Ellet, Jr., Civil Engineer, of Philadelphia.

Mr. Ellet proves, in my opinion, most satisfactorily, that the cause

of so many failures in railroad enterprises in the United States, is not to be traced to any defect in the system itself, but to the injudicious application of the resources of the companies, to the accomplishment of the object to be effected.

There has been much more money expended on many of our railroads, than either their present or prospective resources could possibly justify. Even admitting that the anticipations of their warmest advocates, as to their probable amount of trade, had been fully realized, a little calculation would show that an expenditure altogether disproportionate even to *that* amount has been thoughtlessly lavished on many of our enterprises. Indeed they have, with, however, several honorable exceptions, been commenced, and carried on, with so little reference to the principle of adapting the means to the end, that it is only matter of surprise that so great a number of them sustain themselves even so well as they do.

This position is so amply supported by the numerous failures to realize the anticipated results that were to follow the construction of many of our railroads, as to need no labored arguments in its behalf. The fact speaks for itself more convincingly than any thing I could say on the subject; indeed, I am not certain that I should have ventured to enter my feeble protest against our present heedless system of railroad making, had I not been sustained by so incontrovertible an argument: for when the current of public opinion once sets strongly into a determined channel, no matter how ill directed its course may be, it is rarely that good results to him who ventures to stem it. It is only after the vessel, entrusted to its stream, has struck upon the rocks, that one may, without apprehension of censure, strive to save the fragments of the wreck, or mark out the dangerous spot upon the chart.

The chief cause of these failures has been, as Mr. Ellet remarks, our want of attention to first principles. We are too much an *imitative* people; and, in our endeavours to keep pace with England, whose vast pecuniary resources, and concentrated commerce, enable her safely to reduce to practice those abstract principles, the union of which constitutes the "beau ideal" of a railroad, we overlook the great disparity that exists in the trade and financial capacities of the two countries;—almost unlimited in the one, but comparatively restricted in the other.

The moment news reaches us of some important change in railroad policy adopted by the mother country, no matter what expense its application necessarily involves, our engineers are not content until they effect its introduction upon the several works under their charge.

Now there is certainly nothing culpable in this disposition to avail

ourselves of the experience of others;—on the contrary, where a *parity of considerations exists,* it is wise to follow the beaten track. But it is equally certain that a blind adoption of every abstract improvement—without regard to any existing disparity of means or of secondary causes calculated to neutralize its beneficial effects—may be justly deprecated.

The engineer, before he can decide properly on the details of his location, superstructure, machinery, &c., must ascertain as an essential element of his decisions, not only what is the probable *amount* and *nature* of the trade which the road will be required to accommodate, but whether or not it will present itself in such quantities, and at such intervals of time, as will admit of loading the engines nearly up to their full capacity of draft.

If the trade is so heavy as to require many engines, and so regular that nearly full loads may be depended on, he will of course find it advisable to encounter great expenses for light grades, heavy rails, and powerful engines; because, abstractly considered, a certain amount of power is much more economically maintained, and applied through the medium of one large engine than of two or more smaller ones; and the use of such powerful engines necessarily involves that of proportionally heavy rails and superstructures.

Again, still further to reduce the number of engines by enabling them to draw maximum loads, the grades, or acclivities of the road, must be reduced as much as possible.

A perfect railroad would be that on which the least imaginable force would draw the greatest imaginable load; such a road is evidently a theoretical one; it can never be attained in practice; but it is the duty of the engineer to approximate to it in every instance, as closely *as the trade of the road, and the interest of the company, will admit.*

It follows then, that the above considerations of grades, weight of engines, rails, &c., although not reducible to any one fixed rule for their application to practice, still have certain limits which we may not transcend with impunity. It is plain that every railroad, to some extent, constitutes a case by itself;—it requires its own peculiar calculations; and the engineer must modify, and remodify, his assumed outlays for gradients, curves, engines, rails, &c. until he attains that happy medium in each, and consistency in all, that will best subserve *the interests of the company. That* must be his guiding principle; and if he hopes in every case to attain that end, by simply making for them a railroad combining in itself all the improvements of the age, the chances are greatly in favor of his being disappointed.

It is not the *best railroad,* but the *best paying* railroad, that should

be aimed at; and the two are by no means necessarily associated in our country, except in comparatively few instances.

Experience has shown that we may assume the annual expense of running such engines as are now in common use on all our railroads, at about $5,000 each; and as $5,000 is the interest at 6 per cent. on $83,333, we see that the engineer may very properly incur considerable expense in diminishing the number of engines requisite for maintaining the traffic of the road. But it happens on many of our railroads that the number of engines employed, is less dependent on the grades, or even on the amount of transportation, than on the *number of trips* which the nature of the business requires to be made daily. This business may be so great as to yield a fine revenue, and yet not of such a nature as to require either high grades, heavy rails, or powerful engines; but on the contrary, such that if grades, rails, and engines of this kind be provided for it, the result must inevitably be a failure of the enterprise.

Such are the cases that constitute the numerous railroad failures in the United States. Nothing but the want of knowledge of, and attention to, the principles that influence the expenditures warrantable in each instance for the attainment of light grades, easy curves, and heavy superstructure, has led to so general a disappointment among railroad adventurers, and excited sentiments of distrust with regard to the system itself. Indeed no argument could probably be adduced, so favorable to the merits of the railroad cause, as that it has survived the horrible manglings inflicted on it ignorantly by its best friends. It has struggled through a long and well fought contest against both friends and foes; and now stands forth in its might, victorious, though wounded almost to the death.

The grounds of every expenditure on a railroad should be, that the annual saving thereby induced, shall more than counterbalance the interest on the increased cost. To this test, not only the general character of the line, but every deep-cut tunnel, bridge, and other important work along it should be submitted, before it is finally decided on; and this cannot be done, unless the engineer is previously in possession of some general data, as to the amount, nature, and regularity of the anticipated trade of the road.

It is upon this principle that the enormous original outlays on the English railroads are so willingly encountered. The English engineer first ascertains that the transportation will not only justify a first rate road; but that in order to accommodate it, with a due regard to economy, the road *must* be a first rate one.

But our American engineers, *as a class*, do not descend to first principles. It is enough for them, that such and such improvements

have been introduced in England;—omitting all considerations of the premises, they look only to the conclusions; and the imitative faculties are forthwith called into requisition, without any regard to the modifying, and controlling circumstances peculiar to their own case. They dash on blindly in their operations, deluded by the impression that they cannot err, if they only adhere closely to their English copies. Deep cuts, high embankments, heavy rails, powerful engines, long tunnels, expensive masonry, &c. &c. are all decided on, as matters of course, whenever an opportunity offers, without a moment's reflection that the interest on their cost may never be repaid by their services—but that, on the contrary, they must for ever operate as drains on the annual revenues of the company.

Yet with the data of probable amount and nature of the trade, together with the expenses of transportation as now developed by experience, the adoption or rejection of all these things admit of an easy determination. But unfortunately it is easier to point towards England, than to make calculations even of the most simple character.

This servile imitation, or rather attempt to imitate the splendid practice of the English engineers, without either the motives, or the means for carrying it out, has been the source of incalculable injury to the railroad cause in the United States. All would be well, were we content to investigate the *principles* upon which their practice is founded; for by adhering to those principles, we should, (as would they also in our circumstances,) arrive at a system of construction entirely different from that which their unlimited trade, and equally unlimited finances, now warrant them to adopt. The same *principles*, lead to ***totally different practice***, in different circumstances.

Having ascertained, approximately, the probable amount and nature of the trade which the road will be required to accommodate, and knowing pretty nearly the rates of carriage it will bear, we arrive at a sum which constitutes the gross annual receipts of the road. If from this amount we deduct a portion sufficient to defray the annual expenses, we have the yearly profits. These profits are the interest on the principal which we will be justifiable in expending on the construction and furnishing of the road.

Self evident as the propriety of this simple precautionary process of calculation is, and impossible as it would appear to be, (and acttually is,) to decide properly on the character of the contemplated road, and its machinery, without it, yet it has not probably been resorted to by the engineers of one road in ten that has been constructed in the Union. When the engineer commences his location, his aim almost invariably is, to obtain the *best* abstract line; and whether his road is to obtain 5,000, or 50,000 tons annually, the character of his

grades, curves, superstructure, machinery, &c., will be precisely the same. His standard of propriety is an invariable one; it adapts itself to no contingencies; it admits of no accommodation to difference of objects to be effected. It is summed up in the brief sentence, "the English do so."

The usual routine is pretty much after this manner, viz: the survey is made; the map drawn; and the grades and curves laid down *without any reference to the object or cost of the road;*—then the calculations of cost are made;—and finally, to make both ends meet, an exhibit of probable revenue is concocted, *to suit the Report!*

The road is made; it does not pay; the railroad system "won't do." I do not mean to insinuate that this mode of proceeding is resorted to with the intention to deceive; but that it does deceive, and that ruinously, is undeniable. We are apt to be led astray by our prejudices in favor of any project in which we are personally interested. Every engineer considers his road to be a little more important than any other in the world; and under the influence of such feelings, imaginary freight flows to it, from all quarters, without limit. Like the Legislator's conscience, it is "equal to any emergency;" and it is unfortunate that it is so. Were it otherwise, reports and profits would coincide much more nearly. Now, most of our railroads that have failed to pay well, have been constructed principally for the purpose of accommodating, from two to four times a-day, the passengers, baggage, and freight brought to them either by some other connecting line of railroad, or by stages, or steamboats. But few, if any, of those connecting large cities may be considered as failures. I hope to show that to conduct such a business as that represented in the first case, does not, as is generally supposed (and practiced on) necessarily involve a company in enormous expenses, for easy grades, powerful engines, and heavy rails. In attempting this, I shall, for the sake of illustration, suppose a case, and carry it through.

The amount thus to be transported, say only twice a day (once in each direction) may, generally speaking, be carried by a single light engine, weighing, with her complement of fuel and water, not more than six tons, over grades as high as sixty feet to a mile, by merely slacking her speed at such points.

Let us suppose that an engine of this light weight, would take, over such grades, a gross weight of only thirty tons, exclusive of her tender; and let us see how much business one such trip daily, in each direction, would amount to in a year, of 300 working days. At first sight, this may appear to many of my readers, like taking a very contracted view of the subject; but before we conclude, it may, perhaps, assume a somewhat more imposing aspect. The six ton engine is

assumed merely to show how small a power can, on a railroad, satisfy a considerable business. In practice I should recommend, for such a superstructure as is hereafter described, eight ton engines.

Gross load of an engine weighing six tons, with her compliment of fuel and water in the boiler, but exclusive of her tender, over grades of sixty feet to a mile.

	Tons
40 passengers and their baggage,	4
Passenger cars, - - -	7
Freight, - - -	12
Freight cars, - - -	7
Total, - - -	30 tons, gross load.

Now if we suppose only one such trip daily in each direction, and assume 300 working days to the year, we have annually,

24,000 passengers.
7,200 tons freight.

Let our road be fifty miles long;—the charge for passengers $2.50;—and for freight $4 per ton. Then we have for the gross income of the road,

24,000 passengers, at $2:50,	$60,000
7,200 tons freight, at $4,	28,800
	$88,800 gross annual receipts.

And this, it will be remembered, may be accomplished by two engines, (one for each direction daily) so small in comparison to those which are now coming into favor for *all* roads, as to appear like models: and over grades of sixty feet to a mile, with an eight ton engine, an addition of about fifty per cent. might be made to the above amount of trade and income, with but a trifling increase of expense. But now let us see whether so small an income as $89,000 per annum, would justify the construction of a railroad fifty miles in length.

Experience has shown that the annual expenses of our railroads, generally range within from thirty to fifty per cent. of their income; varying, of course, with many circumstances, which it would not be to our purpose to expatiate on in this place. There can be little doubt that these expenses would be materially diminished on most of our roads, by the use of lighter engines and cars, lower rates of speed, and Kyanized timber for the superstructure; but, although our road contemplates all those conditions, still we shall assume fifty per cent. of the gross receipts, as necessary to defray the gross expenses.

If then from the $89,000 of gross income of our road, we deduct fifty per cent. (say $45,000,) for expenses, there remains the sum of

$44,000 of clear annual profit. Now $44,000 is the interest at eight per cent. on a capital of $550,000; which amount, and no more, we would be justifiable in expending in the construction, and equipment, of a railroad fifty miles in length, intended to accommodate so small a trade as we have assumed, in our example; and required to realize dividends of eight per cent. per annum.

If from this capital of $ 550,000, we set aside $ 50,000 to cover the expense of furnishing our road with engines, cars, water-stations, depots, &c., there still remains $ 500,000, for the construction of the road itself; which in this case, is equal to $ 10,000 per mile.

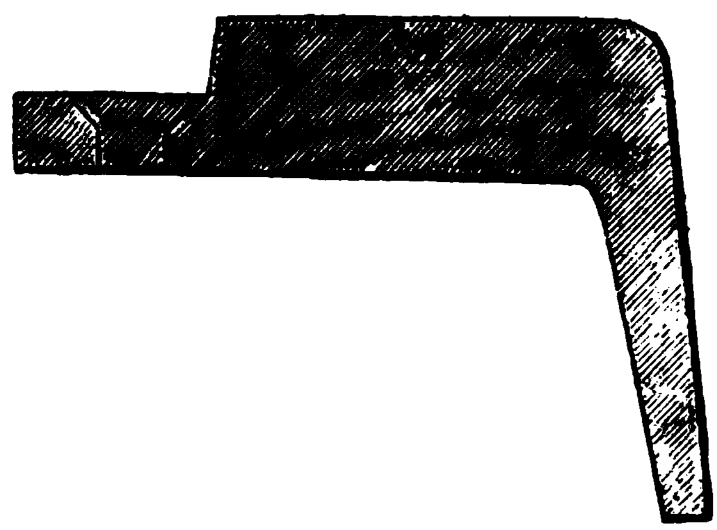
Here then it is evident, that if we wish "to keep up with the age," and to build a road of the best *abstract* character, our project must be abandoned; because the sum of perhaps from $ 20,000, to $ 30,000 per mile, would be required to construct such a one. And although we should even be convinced that at some future day, distant perhaps ten or twenty years, the road would, by the gradual accumulation of business, be able to realize profitable returns on this large investment, still adventurers could scarcely be found so confiding in these prospective advantages, as to embark their capital in it.

But in the case before us, I should certainly advise not to keep up with the age; but to go back to those ancient times, some five or six years past, when flat bar roads were in fashion; the old flat bar road, that has been so unmercifully crushed out of existence by our mammoth engines, of the present day. I entertain a high regard for the flat bar road; and conceive that the odium which is now attached to its memory, has not been justly incurred. Does it follow, as a matter of course, that because it is not adapted to very heavy trades, necessarily involving the use of powerful engines, and a resort to high velocities, that therefore it may not be very serviceable, nay, more serviceable than any other, in cases where the limited business admits of lighter engines, and does not justify the construction of a more expensive road? The outcry against the flat bar road, has, in my opinion, but little foundation in justice. It is, like our more permanent structures, good in its place; and its place is, where light engines, moving at moderate velocities, can satisfy all the demands of the trade at less expense, than heavy engines on the more permanent roads can do. And such cases are very numerous. The reader cannot, I presume, infer from this, that I should recommend to substitute the flat bar for the 75 lb. rail on the Liverpool and Manchester road; in that event, I should, beyond all controversy, be "behind the age;" but, by inversion, I conceive that any one who should advise to employ the 75 lb. rail, at its enormous expense, upon a road on which the cheap light bar would answer every purpose, would be equally open to censure.

However, we are digressing from our subject; let us see what kind of railroad we can construct for $ 10,000 per mile.

In the first place, I would limit the weight of the engines to the maximum of eight tons; and would allow no greater weight on any one engine or car, than one ton. The speed of passenger trains should not exceed twelve or fifteen miles per hour; nor that of freight trains seven or eight miles. The grading, it is needless to say, should be for a single track; the acclivities should coincide as nearly with the natural surface of the ground as the maximum would admit of, provided said maximum did not seriously interfere with the time of making the trip, or render assistant power necessary. Sudden changes of grade should of course be eased by vertical curves. But trifling expense should be incurred for horizontal curves of greater radius than about 1500 feet; and should any very serious object require it, I should admit of radii as short as 300 feet.

The superstructures if not piled,* should consist of log cross-ties, and of six by six inch strings, supporting a flat bar, or rather *flanched* bar, similar to that on the South Carolina railroad; but smaller, as shown in the figure, two thirds size.



Finally, the whole of the timber should be thoroughly Kyanized, or otherwise protected from decay.

Now, so far from expecting this superstructure to be knocked to pieces in a few years, as the old flat bar roads generally were, I should calculate on its annual repairs being less than on perhaps any railroad in the United States: and that, not from any inherent virtue in the road itself, but from the simple fact that *all its parts are fully proportioned to the offices they have to perform.* We should have no crushings or deflections here; but with its light engines, it would be one of the stiffest roads in the Union; and moreover, a much more agreeable one to ride on, than any of those of more permanent construction. Beside which, it would annually yield eight per cent. clear profit in its cost, when doing only the moderate business of one trip daily in each direction, with a small *model* engine, over grades of sixty feet per mile; or, should the business require the use of eight ton engines, it would yield twelve per cent. profit on the same number of trips: or should two trips daily in each direction be necessary with such loads, it would yield twenty-four per cent. profit.

* See my paper on Piled Superstructures, page 226.

Below is an estimate of its cost. If the professional reader should think the item of grading too low, (and it is, I suspect, the only one on which he will have any doubts) let him take the profile of almost any road in the United States, and relocate it, in imagination, so as to adapt it to sixty feet grades, and he will find the allowance to be ample.

Estimate per mile, single track, of such a Railroad as the foregoing.

Grading, culverts, drains, road-bridges, &c.,	$ 4,000
Fencing, (1400 panels at 50 cents, $700; but allowing fencing only half way,)	350
Land damages,	400
Cross-ties—1760, at 25 cents,	440
String timbers, 35 thousand feet board measure, at $ 25,	875
Iron flanched bar—24 tons, at $ 65,	1,560
Splicing plates,	30
Spikes,	100
Workmanship, 1760 lineal yards, at 50 cents,	880
Surveys, engineering, instruments, &c.,	800
Earle-izing, 13,000 cubic feet, at 2½ cents,	325
Incidentals,	220
Total,	$ 10,000

In northern climates, a small addition to this sum would be advisable for broken stone under the cross-ties.

Thus we see, that such a road as we speak of, can be constructed for the moderate sum of $ 10,000 per mile. Yet how many railroads are there in the United States, not enjoying even the limited business to which this road is adequate at two trips daily, on which not only thousands, but tens and hundreds of thousands have been thoughtlessly squandered for light grades, heavy rails, and powerful engines.

[TO BE CONTINUED.]

Facts and Observations on Four and Six Wheel Engines. By JOHN HERAPATH, ESQ.

[CONTINUED FROM PAGE 249.]

London and Birmingham Railway.—Conceiving, the only way I could possibly come to a right conclusion of the cause of any difference in the safety of the engines, was to travel upon them, I procured orders for permission to do so. These orders are absolutely necessary on some of the lines where the injunctions are most strict not to allow any one to go upon the engines. On the London and Birmingham it is as much as a man's place is worth to permit it.

By taking the engine, I was enabled to decide very easily respecting the sinuous motion which is indeed, upon any line in good order, the only sensible motion; for the pitching motion is obviously insensible if the road be good, the draughts steady, and the coupling link about upon a level, or not much above the axle of the driving wheels. The rolling motion, too, I have not yet been able to detect, unless the road was out of order.

My method of judging of the amount of sinuous motion was to fix myself firmly at the end of the engine, and observing how much a point on the front of the frame of the engine deviated to the right or left of the rail, taking as much care as I could to make the visual line fall at the same distance in all engines before the front axle. This is the best practical method I could think of, and though it might not be mathematically accurate, perhaps it would be much more easy to find fault with it than practically to find a better. By a little care one is able to decide pretty correctly in this way, of the difference of sinuous motion between two engines. For instance, if one appears to deviate two inches and another three, which a practised eye can appreciate very well, the one has half as much motion again as the other, and so on. I have thought of, and tried, other ways for the same object, but could find none so satisfactory as this simple plan.

The front rolling motion I have best detected by watching the motions of the front fire-box—not the motion of the chimney, for that is often loose and a bad guide—with regard to the road or rails, taking care, however, to distinguish between it and the sinuous motion. In the hind part of the engine it becomes sensible by leaning one's back or shoulder against the side of the fire-box. In a similar way is the pitching motion discovered, that is, by watching the lifts and depressions of the front of the smoke-box, and by leaning against the hind part of the fire-box. But a person with a sensitive foot, and accustomed to ride upon engines, will soon feel any pitching in the engine. Engines which appear to one standing on the platform to move very smoothly, when tested this way, that is, by leaning against the fire-box, will often develope the most unpleasant motions, and create very disagreeable sensations.

But besides the rolling, pitching, and sinuous motions, some engines have a shuffling motion on the platform from side to side, keeping time nearly with the beats of the pistons. It is made manifest by leaning against the side rails on the platform. Others again have the same shuffling motion in length, discoverable by the same method as the pitching, and distinguished from it by its quickness and regularity, and keeping time with the pistons.

Again, there is often a vertical roughness upon the platform, very different over the same ground on different engines, and a most treacherous guide it is to try an opinion upon; the causes of which I shall describe in my report.

Monday, November 15, I started from Camden Town station on No. 41, taking the morning mail train which was driven by a very intelligent man. This engine, a four wheel one, was one of Mr. Bury's make, and one which, from its being so high, some might call

top-heavy. Its motion, however, was very free from rolling or pitching, except in some few places where the road has suffered from the late bad weather. I could, indeed, perceive no sensible difference between the rolling or pitching motion of this engine, and that of any of the three six-wheel engines, I rode on the Saturday previous on the South Western Railway. The apparent sinuous motion was about two inches, except once or twice when it might have reached two and a half or three inches. This, reduced to the distance of the axles, would make a real sinuous motion of one to one and a half inch. In other respects the engine was very pleasant to ride on, and I understand is esteemed to be a very good one. I stopped at Tring, but when I arrived a Wolverton I very carefully gauged the inside bearing marks of the flanches, and found them to be four feet seven-ninth inches, the gauge of the rails being four feet eight and a half inches. The distance from the extremity of the fire-box to the middle of the hind axle is four and three-quarter feet, distance of the centres of the axles six feet, and total length of the body of the engine, including the fire-box, is fourteen and three-quarter feet. The driving wheels are five and a half feet diameter, the cylinder thirteen inches, and the stroke eighteen inches. I was informed that it consumed twelve cwt. of coke, on an average, between Camden Town and Wolverton, fifteen miles, or twenty-six and a quarter lbs. per mile, but these data we shall hereafter have more accurately. This engine runs up with the night mail and down with the morning mail every day, and has had, I was informed, no material repairs done to it for about eight months.

All the mail train engines are an inch greater in diameter in the cylinders than the engines of the other trains, though the driving-wheels appear to be nearly the same, that is five and a half feet. The coupling link appeared to be about two or three inches above the level of the driving-wheel axle.

This engine is fitted with a guard to clear the rails, and a ballast gauge; that is a bar hung upon a pin coming down a little distance from the inside of the fore wheel to within two or three inches of the level of the axle, on the top of which bar, in a notch, is supported a lever, which, when the bottom of the bar is struck by the ballast being too high, is released, and falling, sets a whistle off; thus telling the tale of the ballasters having neglected their orders as to the height of the ballast where the roads are repairing. This happened in our journey, and was obliged to be reported at head-quarters. Such is the attention to everything on this line which may engender accident.

At Tring I left this engine and waited for the next train, having been informed that all the engines are changed at Wolverton.

The engine I now got on was No. 50, a four-wheel engine, made by Benjamin Hick. Its length, from the end of the fire-box to the axle of the driving-wheels was four and a half feet, ten feet to the fore axle, and thirteen and a half feet the extreme length of the engine. The driving-wheels as before were five feet six inches, cylinders twelve inches, with eighteen inch stroke. This was a much lower engine than the former, and I suspected at first a more steady one, but on getting up its velocity I found it had considerably more sinu-

ous motion, which I suspect was chiefly on account of its flanches being only 4 feet 7.1 inches, to a gauge of 4 feet 8½ inches, and great play in its bearings. The coupling link was placed about the same as in No. 41.

The engine driver informed me that No. 50 consumed about fourteen cwt. of coke in the journey of fifty-one miles, or 30.7 lbs. per mile; but with a strong head wind often-times it made a difference of two or three cwt. more.

At Wolverton I got upon No. 54, another of Bury's engines. This in cylinder, stroke, height, and distance of axles, was nearly a counterpart of No. 41, but its extreme length is half a foot less, and the gauge of its flanches four feet 7.6 inches. It had, therefore, about three-tenths of an inch more play on the rails, and it appeared to me to be less steady than No. 41, and not so lively as No. 50, but steadier. The driver said it consumed a ton of coke in its journey between Wolverton and Birmingham, sixty miles, or about 37.3 lbs. per mile; but the accuracy of his statement I should doubt, as he appeared to be not well-informed. At Rugby I got inside, having traveled eighty-five miles outside in rather sharp and snowy weather upon three of the Company's engines.

I could get no information from the men of any peculiarities in the structure of any of these engines, that is, whether they worked expansively or not, but with all this I expect to be supplied by the Company's officers.

As far as I have yet seen, Bury's engines do not deserve the character given of them of being "top heavy." One thing, however, is to be said that the road, taken altogether, is in so good a state of repair as not to exhibit any imperfections, if they exist. Indeed the term "top heaviness" in a good road is unintelligible; it can be only in roads much out of order, and curves badly constructed, that it can have an existence. On the London and Birmingham line there is no expense spared to make and keep the road in a perfect state of repair, and with a few exceptions it is in excellent order.

But though I can at present see no foundation for the clamour raised against Mr. Bury's engines, I must confess I think they can and ought to be made more comfortable for the men. The platform, for instance, round the fire-box is open at the sides, and bitterly cold, while a very little expense would remedy the defect. Indeed, upon the South Western, Birmingham and Gloucester, and Liverpool and Manchester, engines, that I have ridden on, it is done, and I cannot see why it should not be on the London and Birmingham.

Another fault I have to find with the fitting-up of these engines is, that many of them have no "dashing," or "splashing," guards, over the front wheel. In wet weather the wheels for want of them throw the oxide of iron from the rails, dirt, and particles of ballast, over the engine and the men, in a most annoying degree. Nay, from the several sharp blows I have myself had in the face with these particles, I am inclined to think it is not without danger to the men's eyes, and may therefore deter them from keeping so good a look-out as they otherwise would. The force of this seems now to be seen, for as fast as the engines undergo repair they are provided with splashing guards.

While I am complaining I must also be permitted to prefer another complaint, namely, against the breaks on the tenders. On Mr. Bury's tenders lever breaks are used, upon the arm of which the men stand, over the side between the tender and engine, pressing it down with the weight of their bodies. Should their feet slip, destruction is almost inevitable. Indeed, upon one of these dangerous things a man lately lost his life on one of the lines, and that Company are now preparing what they call shoes for the handles. But if these breaks were fitted as they are upon the tenders of many lines, with a screw and handle, or wheel, all this danger would at once be avoided.

Mr. Bury will not, perhaps, thank me for telling him thus publicly of his faults, but I do it because it is the most effectual way to cure him of committing them again. Besides, to confess the truth quietly, I have a little mischievous inclination just now to grumble and pick holes where I can. It is exhilarating to an exhausted frame, a sort of unction to the bumps and bruises I have gotten in my long and fatiguing journey.

[The rest of this communication we have deferred, the information from the London and Birmingham Railway coming only just before Mr. Herapath's departure.] Railway Mag.

[To be continued.]

Progress of Practical & Theoretical Mechanics & Chemistry.

Remarks on Ships of Wood and Iron.

Remarks on the relative advantages of the employment of wood and iron in the construction of ships have appeared at different times, in Journals devoted to inquiries relating to subjects of this nature, but a spirit of partizanship has been commonly displayed by the respective advocates of wood and iron in favour of their own views. In an endeavour to avoid this charge, it will be expedient to advert in the first instance, to the different modes in which wood can be employed in ship building, especially as the advocates of iron are in the habit of referring to the defects of ships built of timber, which are capable of being obviated by a different system of construction.

The relative merits of wood and iron for this purpose will, I apprehend, come more fairly before the public by an exposition of some of the plans that may be adopted in the construction of ships of wood; and it appears to me that three well marked systems may be distinguished. 1st. The common plan of timbers, whether framed or single, separated by spaces from each other, whose principal connexion with each other, arises from an external and internal series of planking. 2nd. The plan used in her Majesty's dock yards, of timbers wedged up solid, and covered by an external planking, (timbers placed close together I conceive would be found to be a better method.) 3rd. A plan of constructing vessels of any size by two or more connected series of planks without timbers; this method has not been extensively used. Clinker-built boats belong to this third system, and perhaps also iron vessels, inasmuch as the plates of iron of which they are formed are of far more importance than the iron ribs, which occupy the position of timbers.

The advocates of iron have, I apprehend, by no means exaggerated the defects of ships of the common construction, in which the connexion of the timbers with each other is extremely imperfect, even in the best built merchant ships, and the safety of the largest vessels is dependent on the security of the fastenings of the butts of a four inch plank.

I consider these defects are so fatal, that no increase of strength or improvement in workmanship can more than palliate them in a greater or less degree, and I propose to abandon any reference to these vessels, and at once admit their inferiority to vessels constructed of iron, provided the latter are made of sufficient strength.

A large proportion however of the present enormous annual loss of merchant ships seems to have been sufficiently traced to defective methods of construction, and to the facility it affords in covering the defects of cheap ships; still the causes that tend to foster the continuance of the present system are subjects foreign to the tenor of these remarks; the fact that the rottenness of the timbers can be concealed from casual inspection, is sufficient for our purposes. It has been urged that unless spaces are provided between the timbers, for the accommodation of water from leaks, that it would rise in the vessel and spoil the cargo. This argument is founded on the assumed necessity of leaks, but it affords proof of their frequent occurrence in vessels of the usual construction.

The rapid destruction of timber by the united operations of wet, heat and filth, and the generation of foul air from these causes, will not be denied; and in addition to its weakness the rapid deterioration of the frame of the vessel, from the above causes, seems an equally fatal objection—though exceptions may occur owing either to care or accidental conditions.

The second system of ship building with timbers wedged up solid, has been in use for a considerable period for ships of war, and the success that has attended this plan has been amply proved by the accounts of the escape of different vessels, that have since its adoption been driven ashore and got off again, in many instances without injury, and in other cases damaged to such an extent as would have insured the total loss of vessels of the common construction; for instance, the *Pique* lost a large portion of her keel, and in some places the whole of the garboard strake, and a part of the floor timbers were ground away by the rocks of Newfoundland, and yet this frigate crossed the Atlantic without a rudder, under circumstances, it must be admitted, of some anxiety to the officers and crew.

For merchant ships I should propose to use the same weight of materials as are now employed, the outside planking would remain without alteration, but the quantity of wood in the ceiling would be added to the width of the timbers, and in case it was insufficient to fill up the spaces between the timbers, the depth of the latter must be lessened to make up the deficiency.

Under these circumstances the timbers would be about double the thickness of the outside planks, and being placed close together, a good means of connexion might be obtained by large dowells or coaks,

so as to produce a mutual dependence on each other, and so that any pressure on the outside would exert a more regular strain on every part. A vessel constructed on this principle would be an irregular cask, and when caulked inside and outside would float without planking; and by the addition of the latter, a frame of great stiffness, and equal strength and thickness in every part would be obtained, on which one side of every piece of wood used in its construction would be visible, and would allow an examination to be made of its state with great facility. The other sides of the wood would be preserved from wet as long as the fabric of the vessel remained sound, and the caulking was attended to. It is obvious that a greater inside width of seven or eight inches would be gained in these vesels, and no loss of space would accrue if it was occupied by battens to admit of water accommodation for the leakage, and the prevention of injury to the cargo from the escape, until at least the present advocates of the assumed necessity of leaks in ships, became convinced of the small prospect of their occurrence under common circumstances in vessels so constructed.

It is true no provision will afford security to vessels on rocks among breakers, but such situations afford the best test of the merits of different systems of ship building, by the time each vessel is found capable of resisting these effects.

Numerous cases will occur where life is dependent on the time the vessel holds together, but the partial saving of the cargo may be considered objectionable by ship owners, among whom the advantages of a total loss are well understood. Opinions on these points are of little value, we must wait for evidences from wrecks under different conditions.

The scantling proposed for merchant ships would, I apprehend, be not quite so heavy as that in use for ships of war of equal size; at the same time, it is probable that the strength of timbers placed close together, except that of the dockyark plan of timbers wedged up, to such an extent that a greater strength may be perhaps obtained at a smaller cost. Plans of this nature are obviously only suited for good workmanship and good materials; but it ought to suit, for less insurance premiums, whenever an inquiry on this subject is properly conducted, and explanations are afforded to insurers of such a nature, as shall be fully understood.

The third plan referred to, requires similar conditions of timber and workmanship, but it has not been extensively adopted. Ten or twelve series of inch planks were employed many years ago, in a 500 ton vessel built at Rochester, but I conceive three or four series of two and a half to four inch plank, according to the size of the vessel, would be found a more convenient method of construction.

Several of the Gravesend steamers of 150 feet in length have been built of three series of one and a half inch planks, and they have run for four or five years, and are now said to be as sound as when first constructed, such at least was the case with the Ruby, when opened for the purpose of lengthening the bow to increase her speed.

This method however requires further trial, especially at sea, before

any decisive opinion can be given on its comparative merit; it is favourable to soundness, as the necessity of sawing the wood into planks admits of the certain selection of good materials, and would afford great facility in seasoning timber properly. While the expense of selection would in some degree be lessened by the conversion of the rejected planks to inferior purposes, or by working it up in inferior or cheap craft, perhaps for river use. The increase of cost would not answer unless it was accompanied by a proportional increase of durability, and perhaps the general opinion would be in favour of the latter result, as a necessary consequence of the selection of good timber.

The launches used in the navy have for several years been made on Johns' plan, of two series of planks crossed diagonally, their weight is about three-fifths of the boats of the old construction, and their durability has been much increased. The Gravesend steamers are built with two similar series of crossed planks in lieu of timbers, covered with an outside planking in the common mode, the whole well fastened with copper. In large vessels perhaps a ceiling connected in the same manner might be deemed advisable: at the same time it seems probable that a greater strength would be obtained by a less quantity of timber in the third than in the second method of construction proposed. Clinker built, which belongs to this class, in which the principal strength depends on the planking instead of the timbers, seldom exceeds 100 tons in size, and are usually of a light scantling; their great durability is well ascertained, provided they are kept from the ground, in which case from the thinness of the single part of the planking, holes are easily knocked in their bottoms.

The introduction of these methods of constructing timber ships is not likely to be effected, except by the nearly total destruction of the present trade in ship building by the more general adoption of iron vessels, and the interests of humanity will cause the earliest occurrence of this result not to be regretted. Nothing perhaps but the severe pressure of iron competition will induce the present race of ship builders to turn their attention to the means whereby greater strength, security and durability may be given to wooden ships; eventually perhaps its greater strength for a given weight, and its greater elasticity may obtain a preference.

Prime cost undoubtedly will form a principal element in the approaching competition; at present iron vessels are often built too cheap, or in other words too slight; the error may be, and I believe has been remedied. Innumerable questions will arise relating to the elasticity, strength, and durability of wood, as well as its quality; and also in reference to the destructive action of salt water on iron, the strain on the rivets, &c. &c., which can only be answered by experience.

To a spirited competition between wood and iron I look for the improvement of vessels of both materials. Recently I have met with parties who being engaged simply as owners on the proposed construction of a steam boat, in consequence of the difficulty in the choice of wood or iron, have found it necessary to institute an inquiry re-

specting their relative merits in ship building; these parties but for the difficult of selection, would have gone on in the good old jog-trot way of supposing, that British ships of the old construction were perfect specimens of the art, and would have patiently submitted to the present rates of insurance, as founded on the average loss, deduced from defective ships. The spirit of inquiry once roused among owners of shipping, will I trust lead to results as yet scarcely anticipated.

It matters little to the country whether wood or iron eventually obtain the preference; if British oak is abandoned it will be only superseded by British iron, and the inhabitants of our land ought to be satisfied if the latter will uphold the character of the navy as well as the former has done.

At present I consider the question of relative superiority as undecided, and though disposed to admit the inferiority of timber vessels of the common construction, yet the advantages of iron may not exceed that due either to the methods of construction adopted in the navy, or in the Gravesend steam boats. The latter method is perhaps best adapted for small, and the former for large vessels. Moreover, we want the evidence likely to be afforded by the wreck of the largest iron steamers, for the formation of an opinion respecting their powers of endurance under the breakers of a rocky shore, or a sand bank.

In regard to the relative advantages of the two plans of ship building proposed for the merchant service, the method adopted in the navy has received the stamp of experience, and the evidence is conclusive in its favor. The 500 ton vessel built of planks before alluded to, was driven ashore in a heavy gale under Mount Batten, in Plymouth Sound, when loaded with ordnance stores, in company with ten or eleven other vessels, all of which became total wrecks; she afforded an almost solitary instance of a vessel saved, when ashore on that point, and she is reported to have rebounded from the rocks for a short time like a cask, until a hole was knocked in her bottom; after the gale she was got off, and was repaired at a moderate expense, and proceeded on her voyage to the East Indies.

I should also be inclined to the opinion that a greater strength will be obtained with a less quantity of materials, by means of several series of planks than by close timbers and outside planking, but the latter plan seems to afford greater facility for repairs. In conclusion, I would remark that it is my object to assert the possibility of the introduction of great improvements in the construction of vessels of wood, without any increase and perhaps at some reduction of cost, and I wish to induce parties engaged in ship building to advert to the fact, that the best portion of their business, the construction of steamers, is rapidly passing out of their hands, and that unless sailing vessels are rendered stronger, safer, and perhaps lighter, this portion of their trade may follow, as the establishments for building iron vessels are increased, or at least such a depreciation of prices may occur as will be equally ruinous to them.

At the same time I must acknowledge that great improvements in regard to strength have been necessary, and have been adopted in many of the larger steamers, in some instances perhaps to the full ex-

tent here advocated, at least in the engine room; similar principles might be adopted in the fore and after bodies with lighter timbers, and hence a less strain would be thrown upon the midship body in passing over heavy seas. It is their general adoption that I would urge, and I cannot but express my conviction that steam ships of the largest class yet made, may be constructed to bear the winter seas of the Atlantic, by a better disposition of the timbers employed in their construction. Y.

Civ. Eng. & Arch. Jour.

On the Extraction and Decolorization of Gelatine. *By* J. C. Booth and M. H. Boye.

In a patent granted to S. G. Dordoy, of Surrey County, "for certain improvements in the manufacture of gelatine size and glue," (see London Journal for January 1842,) the patentee proposes the employment of chlorine, for bleaching the materials employed, previously to the extraction of the gelatine, in which respect the patent mainly differs from former attempts at bleaching by operating on the gelatinous fluid after its extraction.

"For every 100 lbs. of the animal substances, eight ounces of chlorate or chloride of lime, potash, soda, baryta, or other similar compounds are dissolved, or thoroughly mixed in, or with, two, or more, gallons of hot or cold water; four pounds of hydrochloric or other acids being added and stirred thoroughly. This mixture is to be poured into the vessel containing the water and animal substances, the materials being stirred continually while the mixture is added. The animal substances should be kept entirely covered with the water for twenty-four hours."

The above proportions are considered sufficient for thin skins, as of sheep, but for heavier pieces, such as those derived from oxen, calves, &c., two or three steepings will be requisite, each continued the same time, until the substances appear of a uniform, transparent whiteness. The substances are thoroughly washed in pure water at ordinary temperatures, and then water at 160° Fahr. is poured on, and the temperature maintained at 100° Fahr. from twelve to twenty-fours hours, when the gelatinous solution is strained off. Fresh supplies of water are successively added, each portion at a temperature of 20° higher than the preceding, until at last the water is boiled.

This patent, like many others, makes a sweeping claim "to cover all the ground," but it might be restricted to the use of chlorine or its compounds with oxygen for bleaching animal matters previous to the extraction of gelatine, and not subsequent to this process, which had been repeatedly tried. In the latter case it has been found that although the color of the gelatine may be improved, its binding quality is materially impaired; but there is every reason to believe that the coloring matters may be obviated by the application of bleaching previous to extracting gelatine, since it is the opinion of chemists that this substance is not ready formed in the animal matters employed. Since then the patent contains good principles, it may be well to enquire into some of its details.

As is too often the case with chemical patents, its descriptions are vague and incompatible with the definite laws of chemistry. Thus it is not immaterial whether we employ the same amount of acid (of what strength?) with the same quantity of chlorate of potassa, soda, lime, or baryta, or with the chlorides of the same bases. Probably the chloride of lime is the only compound that can be employed economically; and in this case, if, as the patentee directs, the acid, which is twice as much as necessary, be poured first into the solution of the chloride, a considerable amount of chlorous or bleaching material will be lost. It would be advisable either to dissolve the chloride in two or more gallons of cold water and then add the acid previously diluted with three or more gallons of water, or to add the clearly drawn off solution of chloride to the water over the animal substances, and then to add the acid diluted largely with water. In either case, a bleaching liquor will be obtained which will act more uniformly and for a greater length of time without being exhausted.

The successive extraction of gelatine by water at low and increasing temperatures is worthy of notice, although not novel, but in this case the later solutions should be employed for gelatine of decreasing qualities.

On the Preparation of Aluminous Mordants. By James C. Booth and M. H. Boye.

Whatever relates to improvements in dyeing and cloth printing being of high importance, we have thought it worth calling attention to the above subject from the appearance of two patents, the one taken out in England by R. Hervey, (Rep. Pat. Inv., December 1841,) and the other in this country, (Jour. Frank. Inst. March, 1842.) They are worthy of consideration from the comparative cheapness with which the aluminous mordants may be prepared.

The most important point is the formation of sulphate of alumina by the direct action of sulphuric acid upon clay which has been calcined in a reverberatory furnace. Supposing the process to be successful, as described by the patentee, it offers great advantages, since an abundance of clay comparatively free from iron may be obtained in many districts of country, and even a portion of that iron must be rendered insoluble by calcination. In one respect the sulphate of alumina may be more advantageously employed as a mordant or color-base than the sulphate of alumina and potassa (common alum) since a given weight of it will contain a larger proportion of color-base than the same weight of alum; but, on the other hand, crystalized alum is so uniform in composition, that in its employment we operate more definitely and certainly, according to given weights, while the sulphate of alumina is difficult to be brought to a crystaline state. It is, moreover, liable to form basic salts, so that we cannot know with certainty and readiness the exact amount of alumina present in a solution of the salts. For these reasons the patentee is in error in supposing that the sulphate of alumina is superior to alum for printing, dyeing, &c.

The sulphate of alumina may be more successfully employed in the manufacture of the acetate, by means of acetate of lime or lead, for by decomposing alum perfectly, it is requisite to add a sufficient quantity of acetate to precipitate the whole of the sulphuric acid, not only that combined with alumina but also with the potassa, so that a considerable amount of the acetate is employed to no useful purpose; whereas for every proportion of the sulphate of alumina alone that is decomposed by an acetate, an equivalent quantity of acetate of alumina is formed. The most economical method is to precipitate with *acetate of lime* as long as a precipitate is formed, and then to throw down the small balance of sulphuric acid by *acetate of lead.* The second method described in the English patent, of precipitating alumina by alkali, or its soluble carbonate, and then redissolving the alumina in acetic acid, may often be practised economically, but there is then some difficulty in obtaining a liquid of uniform strength.

The remarks which have been made apply to both the American and English patents, and particularly to the latter, which is more copious. Since each of the points claimed in the patents has been the subject of previous experiments and manufacture, it appears to us that it would be a difficult matter to sustain the combination since other simple methods of removing the iron may be resorted to.

On an Uniform System of Screw Threads—communicated to the Institution of Civil Engineers, 1841. *By* JOSEPH WHITWORTH, ESQ., ASSOC. INST. C. E.

The screw threads which form the subject of this paper, are those of bolts and screws, used in fitting up steam engines and other machinery. Great inconvenience is found to arise from the variety of threads adopted by different manufacturers. The general provision for repairs is rendered at once expensive and imperfect. The difficulty of ascertaining the exact pitch of a particular thread, especially when it is not a submultiple of the common inch measure, occasions extreme embarrassment. This evil would be completely obviated by uniformity of system, the thread becoming constant for a given diameter. The same principle would supersede the costly variety of screwing apparatus, required in many establishments, and remove the confusion and delay occasioned thereby. It would also prevent the waste of bolts and nuts which is now unavoidable. The impulse and direction given to machinery during late years have tended to increase these evils, and must ultimately lead to a change of system.

Were an uniform system adopted for marine or locomotive engines, there can be no doubt that it would be extended to engines and machinery of almost every description. Peculiar threads will, of course, be always required for particular purposes; but in screws for general use in fitting up machinery, the advantage of uniformity would be paramount to every other consideration.

It does not appear that any combined effort has been hitherto made to attain this object. As yet there is no recognized standard. This

will not be a matter of surprise, when it is considered that any standard must be to a great extent arbitrary. It is impossible to deduce a *precise* rule from mechanical principles, or from any number of experiments. On the other hand, the nature of the case is such that mere approximation would be unimportant, absolute identity of thread being indispensable.

Messrs. Whitworth & Co. were led some years ago to alter the threads of their screwing tackle on this principle, in consequence of various objections urged against those they had previously adopted, and the result of the experiment has been abundantly satisfactory. An extensive collection was made of screw bolts from the principal workshops throughout England, and the average thread was carefully observed for different diameters. The ¼, ½, 1½ inches were particularly selected and taken as the fixed points of a scale by which the intermediate sizes were regulated. The only deviation made from the exact average was such as might be necessary to avoid the great inconvenience of small fractional parts in the number of threads to the inch. The scale was afterwards extended to six inches.

The pitches thus obtained for angular threads are shown in the following table:

Diameter in inches.	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$
Threads to the inch.	20	18	16	14	12	11	10	9	8	7	7
Diameter in inches.	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$
Threads to the inch.	6	6	5	5	$4\frac{1}{2}$	$4\frac{1}{2}$	4	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{4}$
Diameter in inches.	$3\frac{1}{2}$	$3\frac{3}{4}$	4	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6
Threads to the inch.	$3\frac{1}{4}$	3	3	$2\frac{7}{8}$	$2\frac{7}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{5}{8}$	$2\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{1}{2}$

It will be observed that above one inch diameter the same pitch is used for two sizes. This could not have been avoided without introducing small fractional parts. The economy of screwing apparatus was also promoted by repetition of the thread. Lon. Mec. Mag. Oct. 1841.

On a Voltaic Process for Etching Daguerreotype Plates. By W. R. Grove, Esq., M. A., F. R. S., *Professor of Experimental Philosophy in the London Institution.**

Dr. Berres, of Vienna, was the first, I believe, who published a process for etching Daguerreotype; his method was to cover the plates with a solution of gum-arabic, and then to immerse them in nitric acid of a certain strength. I have not seen any plates thus prepared, but the few experiments which I have made with nitric acid, have given

* From the Proceedings of the London Electrical Society, Part II, having been read before the Society on the 17th of August, 1841. Revised by the Author.

me a burred and imperfect outline; and I have experienced extreme difficulty of manipulation from the circumstance of the acid never attacking the plate uniformly and simultaneously. My object, however, in this communication, is not to find fault with a process which I have never perhaps fairly tried, or seen tried by experienced hands, and the inventor of which deserves the gratitude of all interested in physical science; but to make public another, which possesses the advantage of extreme simplicity, which any one, however unskilled in chemical manipulation, may practise with success, and which produces a perfect etching of the original image; so much so, that a plate thus etched can scarcely be distinguished from an actual Daguerreotype, preserving all the microscopic delicacy of the finest parts of the impression.

One sentence will convey the secret of this process; it is to make the Daguerreotype the *anode** of a voltaic combination, in a solution which will not of itself attack either silver or mercury, but of which, when electrolyzed, the anion will attack these metals unequally. This idea occurred to me soon after the publication of Daguerre's process; but, being then in the country, and unable to procure any plates, I allowed the matter to sleep; and other occupations prevented for some time any recurrence to it.

Admitting the usual explanation of the Daguerreotype, which supposes the light parts to be mercury, and the dark silver, the object was to procure a solution which would attack one of these, and leave the other untouched. If one could be found to attack the silver and not the mercury, so much the better; as this would give a positive engraving, or one with the lights and shadows, as in nature; while the converse would give a negative one. Unfortunately, silver and mercury are nearly allied in their electrical relations. I made several experiments with pure silver and mercury, used as the anode of a voltaic combination; but found, that any solution which would act on one, acted also on the other. All then that could be expected, was a difference of action. With the Daguerreotype plates I have used the following:—

Dilute sulphuric acid, dilute hydrochloric acid, solution of sulphate of copper, of potash, and of acetate of lead. The object of using acetate of lead, was the following:—With this solution, peroxide of lead is precipitated upon the anode; and, this substance being insoluble in nitric acid, it was hoped that the pure silver parts of the plate, being more closely invested with a stratum of peroxide than the mercurialized portions, these latter would, when immersed in this menstruum, be attacked, and thus furnish a negative etching. I was also not altogether without hopes of some curious effects, from the color of the thin films thus thrown down; here, however, I was disappointed: the colors succeeded each other much as in the steel plate used for the

* Strictly speaking this is a misapplication of Faraday's term: he applied it to the surface of the electrolyte; as, however, all continental and many English writers (among whom I may name Whewell) have applied it to the positive electrode, and as an expression is most needed for that, I have not hesitated so to apply it.

metallochrome, but with inferior lustre. On immersion in nitric acid of different degrees of dilution, the plates were unequally attacked, and the etching burred and imperfect. Of the other solutions, hydrochloric acid was, after many experiments, fixed on as decidedly the best: indeed, this I expected, from the strong affinity of chlorine for silver.

I will now describe the manipulation which has been employed by Mr. Gassiot and myself, in the laboratory of the London Institution, with very uniform success. A wooden frame is prepared, having two grooves at 0.2 of an inch distance, into which can be slid the plate to be etched, and a plate of platinum of the same size. To ensure a ready and equable evolution of hydrogen, this latter is platinized after Mr. Smee's method; for, if the hydrogen adhere to any part of the cathode, the opposite portions of the anode are proportionately less acted on. The back and edges of the Daguerreotype are varnished with a solution of shell-lac, which is scraped off one edge to admit of metallic connexion being established. The wooden frame with its two plates, is now fitted into a vessel of glass or porcelain, filled with a solution of two measures hydrochloric acid, and one distilled water (sp. gr. 1.1); and two stout platinum wires, proceeding from a single pair of the nitric acid battery, are made to touch the edges of the plates, while the assistant counts the time; this, as before stated, should not exceed thirty seconds. When the plate is removed from the acid, it should be well rinsed with distilled water; and will now (if the metal be homogeneous) present a beautiful sienna-colored drawing of the original design, produced by a film of oxychloride formed;—it is then placed in an open dish containing a very weak solution of ammonia, and the surface gently rubbed with very soft cotton, until all the deposit is dissolved; as soon as this is effected, it should be instantly removed, plunged into distilled water, and carefully dried. The process is now complete, and a perfect etching of the original design will be observed; this, when printed from, gives a positive picture, or one which has its lights and shadows as in nature; and which is, in this respect, more correct than the original Daguerreotype as the sides are not inverted; printing can therefore be directly read, and in portraits thus taken, the right and left sides of the face are in their proper position. There is, however, *ex necessitate rei*, this difficulty, with respect to prints from Daguerreotypes,—if the plates be etched to a depth sufficient to produce a very distinct impression, some of the finer lines of the original must inevitably run into each other, and thus the chief beauty of these exquisite images be destroyed. If, on the other hand, the process be only continued long enough to leave an exact etching of the original design, which can be done to the minutest perfection, the very cleaning of the plate by the printer destroys its beauty; and, the molecules of the printing ink being larger than the depth of the etchings, an imperfect impression is produced. For this reason it appeared to me, that at present, the most important part of this process is the means it offers of multiplying indefinitely Daguerreotypes, by means of the electrotype. An ordinary Daguerreotype, it is known, will, when electrotyped, leave a faint impression: but in so doing it

is entirely destroyed; and this impression cannot be perpetuated; but one thus etched at the voltaic anode, will admit of any number of copies being taken from it. To give an idea of the perfect accuracy of these, I may mention, that in one I have taken, on which is a sign-board measuring on the electrotype plate 0.1 by 0.06 of an inch, five lines of inscription can, with the microscope, be distinctly read. The great advantages of the voltaic over the chemical process of etching, appear to me to be the following:—

1st. By the former, an indefinite variety of menstrua may be used; thus, solutions of acids, alkalies, salts, more especially the haloid class, sulphurets, cyanurets, in fact, any element which may be evolved by electrolysis, may be made to act upon the plate.

2nd. The action is generalized; and local voltaic currents are avoided.

3rd. The time of operation can be accurately determined; and any required depth of etching produced.

4th. The process can be stopped at any period, and again renewed if desirable.

The time I have given is calculated for experiments made with one pair of the nitric acid battery; it is, however, by no means necessary that this be employed, as probably any other form of voltaic combination may be efficient. It would seem more advisable to employ a diaphragm battery, or one which produces a constant current, as otherwise the time cannot be accurately determined. It is very necessary that the silver of plates subjected to this process be homogeneous. Striæ, imperceptible in the original Daguerreotype, are instantly brought out by the action of the nascent anion; probably silver, formed by voltaic precipitation, would be found the most advantageous. I transmit with this paper some specimens of the prints of the etched plates, and of electrotypes taken from them; and in conclusion, would call attention to the remarkable instance which these offer, of the effects of the imponderable upon the ponderable: thus, instead of a plate being inscribed, as "drawn by Landseer, and engraved by Cousins," it would be "drawn by Light, and engraved by Electricity!"

I would suggest the employment of hyposulphite of soda instead of ammonia to remove the oxychloride. Philos. Mag., Jan. 1842.

London Institution, Saturday, Aug. 14, 1841.

The Artesian Well of Grenoble.

At Grenoble, in the vicinity of the French capital, it was considered advisable some years ago to endeavour to procure good water by means of an Artesian well. M. Mulot d'Epinay was the engineer to whom the task was entrusted. On the 31st of December, 1836, the bore had been carried, after immense labor, to the depth of 383 metres, (a metre is 3 feet and 2-10ths English.) The soil was a clay, very hard and compact. In the month of June, 1839, the bore had reached the depth of 466 metres, and the soil was still a bed of clay, though a variety of strata had been previous passed. M. Mulot kept

a regular journal of observations, relative to the soils and strata penetrated, and the temperature at different depths. This record will be valuable when published. At length, after a task of seven years one month and twenty-six days' duration, M. Mulot was rewarded by a degree of success proportioned to the time and trouble expended. Water was not only found, but found under such circumstances, and in such quantities, as will cause the well to be one of the most useful works as well as one of the greatest marvels of artistical ingenuity in France. The fluid burst out in a perfect torrent, rising to the surface of the bore to the amount of nearly three cubic metres in a minute, or 180 metres in an hour, and 4320 metres in the twenty-four hours. Such is the force with which it flows up the shaft, that it mounts more than thirty-two English feet above the surface of the ground. M. Hemery, director of roads and bridges, has calculated that the force of ascension of the water, at the bottom of the shaft, exceeds, by fifty times, the force with which water rises in a vacuated tube of thirty-three feet. The orifice of the well is fifty-five centimetres (about one foot eight inches) in diameter, and at the bottom it is eighteen centimetres in diameter. The shaft is in all 547 metres, (or 1630 French feet) in depth, and the sides are strongly plated with iron to a depth of 539 metres. The dome of the Invalids, which has an elevation of 300 feet above the ground, is thus only about a fifth of the perpendicular measurement of the Artesian well of Grenoble.

Three times, during the operations, did the shaft give way, but the indefatigable engineer was not daunted, and at last he has had his reward. The water, which the well pours forth incessantly, has converted one of the neighboring streets into a river, but the workmen are at present employed in forming a channel for its proper conveyance from the spot. As might be expected, the fluid was at first mixed with sand and earth, and continued to be so for some time. It is perfectly sweet, however, and had no odor of a disagreeable kind, or any other deteriorating qualities. It is of such a temperature, that there is an obvious smoke arising from it when it reaches the surface. This is a feature not likely to continue, and indeed easily removable before use. The whole cost of this great work of art to the city of Paris is said to have been 160,000 francs. The perseverance in this labour for such a period of deferred success, is to be ascribed to the confidence resulting from modern geological discoveries; and the value of these is most splendidly shown by the success attained. By an ingenious contrivance, M. Mulot has been able to raise large quantities of sand from the bottom of the well; thus clearing the water more rapidly, and also adding very considerably to its force and volume. This removal of the sand has been attended with curious consequences in more respects than one. After ceasing, in a great measure, to throw up sand, the well has begun to throw up shells and petrifactions of various kinds, the debris of a former world. The success of the operations of Grenoble has also induced engineers to make similar attempts in other quarters. One is begun on a large scale at Vienna.

Mining Jour.

Wear of Granite Pavement.

During seventeen months, the following was the relative wear of a pavement made of the granites named, laid down on the Commercial road in London:—Guernsey, 1.0; Herm (an island close to Guersey), 1.19; Budle (a Northumberland whinstone), 1.316; blue Peterhead, 2.08; Heyton, 2.333; red Aberdeen, 2.524; Dartmoor, 3.285; blue Aberdeen, 3.571. These differences are very considerable, and are, in a great measure, to be attributed to the mineralogical structure of the stone, granite being composed of at least three species, mica, feldspar, and quartz, of which the quartz is the hardest and the mica the softest. Permeability to wet is also a rapid cause of disintegration, especially in conjunction with frost. It is melancholy to see many of our public edifices rapidly hurrying to decay, from the bad quality of the stone employed in their erection. Great attention should be paid to the qualities of the stone, in selecting railway blocks; although the opinion of railroad engineers is now most inclined for timber bearings. Leaving out the question of first and last cost, longitudinal timbers with iron cross trees, decidedly make the most pleasant road; and the effect of this, not only on the passengers, but the engines and carriages will, in our opinion, put the ultimate cost on one side. We shall not easily forget the smoothness of the Great Western Railway, which was so evident as to admit of no doubt, although when we went on it, we were much prejudiced against it, from what we had heard; our prejudices were soon dispelled.—*Railroad Journal.*

Civ. Eng. & Arch. Jour. Nov. 1841.

Experiments on the Strength of Brick and Tile Arches. By Thomas Cubitt, Assoc. Inst. C. E.

In the course of his extensive building engagements, the author had occasion to construct some fire-proof floors; he therefore wished to ascertain how the greatest amount of strength could be attained, with a due regard to the space occupied, and the cost of the structure.

Two arches were built, each with a span of fifteen feet nine inches, and a rise of two feet.

The brick arch was two feet wide, and composed of half a brick in thickness, with cement.

The tile arch was two feet four inches wide, and built of four tiles, set in cement, forming a thickness of four and a quarter inches.

The spandrels of the arches were filled up level to the crown with rubble work and cement. A load of dry bricks was placed along the centre of both arches, and gradually increased at stated periods, from twelve cwt. three qrs. up to 160 cwt. at the end of seventy-five days, when the abutments of the brick arch gave way; and the tile arch broke down while loading.

Ibid.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Door Locks and Latches;* Enoch Robinson & William Hall, Boston, Massachusetts, March 3.

The latch bolt is connected with the fork, which is operated by the tumbler, or lever, on the spindle of the knobs, by a round shank surrounded by a helical spring—the fork being provided with a separate spring in the usual way. The spring on the shank of the latch should be of less strength than the one on the fork.

The object of this improvement is fully expressed in the following claim, viz: "We claim as our improvement arranging the latch bolt with an additional spring, which shall operate the same on closing the door to which the lock is applied, independently of the spring which acts on the knob, the whole being constructed substantially as herein set forth."

2. For an improvement in the machine for *Hulling Clover Seed;* William C. Grimes, York, Pennsylvania, March 3.

The patentee says,—"In the construction of machines for hulling clover seed, it has been a common practice to depend rather upon acute asperities to break the hull, than upon a more permanent principle, or structure, less affected by use; hence such machines have become speedily defective as they became worn; the seed passing through the machine in a current too thin, or diffuse, for the round teeth or asperities to act with sufficient force upon the light and scattered pods or hulls to break them."

"In my machine the hulling is effected while the chaff and seed (in a mass) is under a pressure produced by centrifugal force; thus the effective power of the machine is rapidly increased with its activity."

A runner is attached to the lower end of a vertical shaft, and is provided with teeth above and below, and on its outer periphery, which is rounded. The teeth on the upper surface extend much nearer to the shaft than on the under surface—the space between the inner ranges of teeth and the shaft being occupied by arms which admit of a current of air to pass upwards. The upper end of the shaft is provided with a fan consisting of arms or vanes—and the whole is surrounded by a case, that part which surrounds the fan, being provided with a valve or damper to regulate the current of air, and the part which surrounds the runner with teeth on the inside, to correspond with and pass between those on the runner.

The grain is fed in through a hopper, that opens into the case near the inner circle of teeth on the upper surface of the runner, and by the action of the centrifugal force it is forced outwards, towards, and around, the periphery, and then along the bottom towards the centre, where

it meets with a strong current of air, produced by the fan at the top, which carries up the chaff and permits the grain to fall down. The centrifugal force resists the escape of the grain at the bottom, but as the body of grain is greater at the top than at the bottom it is forced out.

Claim.—"What I claim as new, and as my invention, and desire to secure by letters patent, is the manner of hulling clover or other seed, under a pressure produced by centrifugal force, after the manner and upon the principle herein before set forth; that is to say, the seed in the hull is passed through a hulling chamber, in which it first diverges from, and then convey it towards, the centre; centrifugal force subjecting the seed and hull to a pressure, less or greater, according to the velocity of the wheel, spheroid or runner, as it passes over or around the bilge or periphery of the same."

Secondly.—"I claim the combination of the fan with the hulling wheel or ring, and operating after the manner, or upon the principle, above described."

Thirdly.—"I claim the mode of regulating or maintaining a nearly uniform current of air through the machine, by means of a valve or door, operating after the manner or upon the principle herein before set forth."

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3. For an improved mode of *Rendering Fabrics Water Proof;* George John Newberg, a citizen of the United States, residing in London, England, March 3; patent to run 14 years from the 12th of May, 1840, the date of the English Patent.

The patentee says—"My improvements in rendering silk, cotton, woollen, linen, and other fabrics water proof, consists in an improved mode, manner, or process, of rendering such fabrics water proof, and is effected by using drying oils and oil compositions, varnishes, or other suitable composition for this purpose, in such a way that one side of the fabric when finished presents an appearance unimpaired, or but little altered, by the process of water proofing, and therefore keeps its original appearance or nearly so, and this I effect by applying siccative, or drying, oils and compositions in such manner that when finished the appearance of one side only of the texture is altered, (that is to say,) the oil, or paint, or water proof composition, coats, or covers, the one side, while it does not cover or injure the appearance of the other side, or but little so.

"One method by which my improved mode, method, or process may be carried into effect is to use oil baths (about a quarter or half an inch deep will be found sufficient) of proper dimensions to allow the frame containing the strained silk, or fabric, to float thereon; the upper surface of the fabric being left exposed to the action of the atmosphere, or artificial heat. Another method, or modification of process, of carrying my improvements into effect is as follows, viz: by merely laying the saturated fabric on a slab, or slate, or stone, or metal, or other surface or material, non-absorbent to oils, or such mat-

ters, and this I consider a more simple and convenient method of effecting the objects of my improvements."

The method of producing damask patterns is thus stated—"Instead of having a plain table, or surface of slate, or of wood, placed in contact with that side of the fabric, part of which is only partially to be protected from the drying action of the air, or heat, I lay, or spread, the saturated silk, or fabric, upon a surface, or table, or block, which has a pattern formed upon it, such pattern being sufficiently countersunk, or raised, (say about one-eighth of an inch) after the manner of ordinary calico, or paper, stainer's pattern blocks. The raised parts of this pattern block, or table, being placed in close contact with one side of the saturated silk, or fabric, that is, the one intended to have the pattern formed upon it and the fabric stretched over it, the indented, or sunken parts, recesses, or interstices of the pattern not being filled with the composition, will allow the water proofing material to harden or become pellicled on both sides in some parts, while the raised parts will prevent such effect taking place."

"I claim, as new and useful, the improved mode, methods, or processes, or modifications above described, of applying substances to such saturated textures so as to prevent one surface thereof from drying, hardening, or forming a pellicle thereon, while the other is allowed so to do by the action of the atmosphere, or artificial heat, to which it is exposed, evaporating a portion of the aqueous or volatile parts of the oils, or compositions, and then afterwards clearing away the moist parts by the agency of spirits of turpentine, or other suitable liquids. And also, I claim the mode, manner, or process of producing damask patterns, or designs, on the surface of such fabrics, in the way or manner above stated."

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4. For a *Refrigerator;* Job S. Gold, city of Philadelphia, Pennsylvania, March 12.

This refrigerator consists of a square, or other formed, double box, with a space between the two, filled in with any bad conductor of heat. The inside is provided with shelves, open at the ends to allow of a free circulation of the air from one compartment to the other. At the top, or upper part, there is an apartment, or reservoir, for ice, and at the side there is another reservoir for ice water, the upper part thereof communicating with the bottom of the ice chamber, and the lower end being provided with a cock for drawing off the water.

The claim is, first, to the separate apartment for the ice at the top or in the upper part of the refrigerator, substantially as described. Second, to the combination of the ice water reservoir and the arrangement of the shelves with the apartment for ice as specified, for the purpose of producing the circulation of air to equalize the temperature, substantially as described. And third, to the ice water reservoir in combination with the apartment for ice, as described."

5. For improvements in the *Drill, or Seed Planter;* Moses and Samuel Pennock, East Marlborough, Chester county, Pennsylvania, March 12.

The claims, as well as the description, under this patent, refer throughout to the drawings, and could not be understood without them. This difficulty patentees might obviate by furnishing suitable cuts, when the whole specification might be published.

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6. For an improvement in the process, or processes, of *Manufacturing Starch;* Orlando Jones, Middlesex county, England, March 12; to run 14 years from April 30, 1840, the date of the English Patent.

The patentee says—"My invention relates to a mode of treating, or operating on, farinaceous matters to obtain starch and other products, and for manufacturing starch, by means of submitting such farinaceous matters to a caustic alkaline process, as hereafter more particularly explained. I would, however, observe that I have not yet found that my invention can be applied with advantage in the manufacture of starch from potatoes."

Claim.—"What I claim as my invention is, first, the mode of treating, or operating on, farinaceous matters to obtain starch and other products, especially flour, or powder, produced from rice, and in the manufacture of starch by submitting farinaceous matters to a process, or processes, of caustic alkaline treatment, as herein described. And secondly, I claim the mode of manufacturing starch from rice by the process, or processes, described."

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7. For improvements in *Circular Saws, and the mode of driving them;* David Philips, Georgetown, Mercer county, Pennsylvania, March 12.

The carriage which carries the log is moved by a horizontal screw, and is provided with two racks, the teeth of which take into two pinions on the shaft of the circular saw, so that the motion of the carriage which feeds the log up to the saw at the same time actuates the saw itself.

The other parts will be fully understood by reference to the claim, which is in the following words, viz:—"I do not claim as my invention the mere attachment of a series of plates for the purpose of making a circular saw, nor making the teeth separate from the plates, as these have been done before, but not, as I verily believe, in the manner specified by me, and therefore what I claim as my invention and desire to secure by letters patent is, the method of attaching the plates, or arms, to the main flanch by letting them into recesses, of the form above described, in the flanch, and having the second flanch, or plate, rivetted, or bolted, to the main flanch, embracing the plates, or arms; they, the plates or arms, being provided with long slots through which the rivets, or bolts, pass, and a key passing through the flanch and plate, and through a notch in the end of the arms, for the purpose of regulating the sweep of the teeth in their revolution as described.

I also claim the guide attached to each plate, or arm, in front of each tooth, for the purpose and in the manner described; also the method of fastening the teeth to the arms by means of the dovetailed wedge cap, as above described. And finally, I claim the method of giving motion to the saw, or saws, by means of the combination of the screws, the rack, or racks, attached to the carriage, and the pinion, or pinions, attached to the saw shaft, so that the motion of the carriage, received from the screw, shall give motion to the saw, or saws, as described."

8. For an improvement in the *Ploughing and Planting Machine;* Justus Rider, Woodburn, Waconssin county, Illinois, March 12.

The reader is referred, for an explanation of this implement, to the claim, which is in the following words, viz:—"What I claim as my invention, and desire to secure by letters patent, is the combination of a cultivator, or of ploughs for the preparing of the soil, to receive the seed, consisting of an opening share with two coverers behind it, with a seed drill having an opener in front with two coverers behind, the seed being deposited at the back of the opener—the arrangement of the share constituting the cultivator preceding those of the seed drill, as set forth."

9. For improvements in the *Horizontal Wind Mill;* John M. Van Osdel, Chicago, Illinois, March 12.

We are under the necessity, in this instance, of omitting the claims, as they refer throughout to the drawings, and could not be understood without them. The mill is horizontal, and as the sails are carried around they turn on their axes so as to present their surface to the wind in the best position to receive the action of the wind to impel the mill. The general position of all the sails can be shifted as the wind changes, whilst the mill is in motion.

10. For improvements in the mode of *Constructing and Propelling Steam Vessels;* William W. Hunter and Benjamin Harris, Norfolk, Virginia, March 12—antidated November 2, 1840.

The patentees say—"The nature of our invention consists in providing the vessel with an arch deck, called a shield deck, faced with iron, which facing forms, with the direction of any missive discharged from cannon afloat, an angle over 130°, and will therefore glance, or throw, off said missive. Said shield deck, in combination with the parts of the vessel below it, gives (by its displacement of water) a buoyancy, by which said vessel will float, though the vulnerable parts of said vessel be pierced, or torn by shot, so as to admit all the water capable of entering. The steam engines, machinery, and water wheels, are placed below said shield deck, and every part of them below the water line, therefore out of the reach of shot, and the water wheels being, from their position, always submerged, are relieved from the effect of the sea."

The wheels work horizontally or inclined, in cases, or trunks, built

in the vessel and open at the side. The wheels consist of a drum, with the paddles attached permanently to the periphery thereof. A portion of each wheel projects out of the case, or trunk, beyond the side of the vessel, and the shaft passes through the casing, and the water is prevented from leaking into the vessel by means of a stuffing box.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the application of shield decks to vessels constructed of metal, or wood, whether propelled by steam power or any other, and also the application of submerged water wheels, on the plan described in the accompanying specification, whether placed horizontally, or obliquely, for the purpose of propelling vessels."

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11. For an improvement in the manner of *Manufacturing Butt Hinges, by casting them in combined metallic moulds;* Thomas Shepherd and Thomas Loring, district of Southwark, Philadelphia county, Pennsylvania, March 16.

The patentees say—"We construct our moulds of iron, placing one mould upon another, so as to form tiers, one above the other; and in each mould, at each pouring, we cast a half hinge, the moulds containing, in the first pouring, a pattern which occupies one half thereof, and which is so constructed that it can readily be removed, leaving the half hinge first cast in the mould; and we then, by a second pouring, cast the second half of the hinges. Instead of a joint pin we usually cast the knuckles of one half the hinge with conical depressions, or countersinks, which are to receive conical projections on the knuckles of the other half; but, if preferred, joint wires may be inserted in the ordinary way, the respective halves being cast without conical projections."

"What we claim, and desire to secure by letters patent, is the manner in which we have constructed and combined the respective parts of our combined metallic mould for casting butt hinges, as above set forth; that is to say, we claim the constructing of metallic moulds, so as to arrange them in tiers, one above the other, on each side of a metallic gate; and so as that the said mould shall contain, at the time of the first casting, the pattern in the form of a half hinge, divided so as to deliver readily from the cast half, as herein described. We also claim the manner of combining these moulds so as that the lower side of the pieces shall constitute the half mould for each hinge in the series; and likewise the so forming and arranging them as to render them capable of being reversed for the purpose of casting the second half of the hinge; the whole being formed, constructed and operating substantially as herein fully made known."

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12. For an improvement in *Clamps for Crimping Leather;* Josiah M. Read, Boston, Massachusetts, March 16.

This patent is for a mode of securing the leather to that kind of clamp in which the leather is drawn by a screw that passes through

the clamp and bears against the heel of the crimping board, or form. One of the jaws of the clamp has a stud, which passes through the upper jaw, and then by means of a wedge passing through a slot, or under a shoulder in the stud, the upper jaw is forced upon the under, and thus bites the ends, or corners, of the leather placed between them.

The claim is confined to this device for clamping the leather.

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13. For an improvement in the *Harvesting Machine;* Alfred Churchill, Geneva, Kane county, Illinois, March 16.

This machine is intended for thrashing all kinds of grain when standing in the field, without cutting the straw.

There are two chains, one on each side of the forward part of the machine, which chains pass over rollers, or pulleys, and to which four rods are attached at equal distances apart. Immediately back of these chains and rods is placed the thrashing cylinder and concave, which are of the usual construction; and between the chains and rods, and the thrasher, there is a cap, provided with hooks, which slides up and down. As the machine is pushed forward the rods on the chains catch the heads of grain and push them towards the thrasher, at the same time one of the rods on the chains catches the hooks on the cap, which is thus lifted up, the heads of grain are pushed under, the cap is then relieved, falls on to the grain, and holds it during the operation of thrashing.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described, of gathering and thrashing grain at the same time by means of the revolving rods, and oscillating or revolving cap, constituting the gatherer, in combination with the thrasher and concave, the whole being constructed and operating substantially in the manner set forth."

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14. For an improvement in *Gas Lamps;* Robert Cornelius, city of Philadelphia, Pennsylvania, March 18.

The patentee says that "the improvement consists in the manner of constructing the apparatus for conducting the gas from one of the burners of a hanging, or fixed, lamp, or of a girandole, by means of a descending tube, so as to cause it to issue from a burner at a convenient height for reading or for other purposes."

The end of the tube which is attached to the fixed burner fits into a cup of mercury attached to its base, for the purpose of preventing the gas from leaking out, and another burner is affixed to the lower end of this said tube at any desired height.

Claim.—"What I claim as constituting my improvement in the within described apparatus, is the manner in which I have formed the mercury cup within the body of a burner of brass, or of other metal, by lining the same with sheet iron, and having the jet affixed therein; and in combination therewith, the so constructing the upper end of the descending tube as to enable it to receive and contain the jet, and thus to obviate the necessity of its removal, when said de-

scending tube is to be used; the whole apparatus being constructed substantially in the manner set forth."

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15. For an improved *Machine for Boring the Conical Openings into the composition which constitutes the charge of War Rockets;* Alvin C. Goell, Washington, District of Columbia, March 18.

"It has been the practice heretofore," the patentee observes, "to bore the conical opening required in the composition of war rockets by means of a drill, or borer, running horizontally in a lathe, or other similar apparatus, a process by which the composition has not been freely delivered from the opening, and in the performance of which other difficulties have been encountered. In those cases, also, when it has been deemed necessary to remove the whole charge, the rockets have sometimes been put into water to dissolve out the composition, or it has been removed by other means which were inconvenient and wasteful."

The borer is attached to the upper end of a vertical shaft, to which part of the shaft there is attached a cup, or basin, to catch and retain the cuttings. The rocket is placed in a holder which slides up and down in the frame of the machine to present the rocket to the borer.

Claim.—"Having made known the manner in which I construct my machine for boring war rockets, and arrange and combine the respective parts thereof, I do declare that I do not claim to be the inventor of either of the parts thereof taken individually, nor do I claim the general arrangement of these parts, there having been machines made for other purposes bearing a considerable resemblance thereto; I therefore limit my claim to the particular manner in which I have adapted this instrument to the purpose of boring out war rockets and of collecting and preserving the composition with which the rocket was charged. That is to say, I claim the combining with the borer the cup, or basin, on the shaft, so as to bore out and collect the material from a rocket placed in a holder, or sliding frame, the whole being combined, connected, and operating as herein set forth."

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16. For improvements in the *Mortising Machine;* James King, Morristown, Morris county, New Jersey, March 18.

The shank of the chisel is cylindrical and fits into the end of a slide; and for the purpose of turning the face of the chisel in opposite directions, a pin, or handle, projects from the shank and plays in a notch cut out of the slide for that purpose. A helical spring is put on to the pin, or handle, which spring bears against its head and against the face of the slide, and consequently holds the chisel in its place whether turned with its face one way or the other.

The slide has rack teeth on it into which the teeth of two pinions work—there are rack teeth also on the inner face of the box in which the slide moves, into which one of these pinions gear; and on the shaft, or axle, of this pinion a handle is attached for the purpose of working the chisel; by this arrangement the chisel will be moved

double the distance, through which it would move if the pinion turned on its own axis. The other pinion above mentioned, has a spiral spring wound on its axis in the manner of a watch spring, which is coiled up by forcing down the spring, and which carries back the chisel when the handle is liberated.

Claim.—"What I claim, and desire to secure by letters patent, is the manner of applying and using the spiral spring on the handle for confining the handle in any desired position; and likewise the manner of applying a spiral spring for returning the slide and chisel, in combination with a mortising machine, such as is herein described, the whole operating substantially as set forth."

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17. For an improved apparatus for *Filing Saws;* Nelson J. Wemmer, Philadelphia, Pennsylvania, March 18.

A tube which receives the end of the saw file fits and turns in a block which is placed on, and secured to, a plate which is graduated with radial lines to indicate the inclination of the file. The graduated plate is placed on a table attached to the saw clamp.

The claim is to "the use of the block in combination with the tube passing through it, which tube receives the point of the file, as set forth. Also the combining with such a block, and its appurtenances, the graduated piece, in the manner and for the purpose set forth."

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18. For an improvement in the *Cross Cut Saw;* Henry Burger, Danville, Hendricks county, Indiana, March 18.

The saw is to be attached to, and strained in, a frame, or gate, and which is made to slide horizontally, by means of a crank and pitman, in the usual way. This horizontal frame is sustained upon a second frame which slides vertically, and is balanced by counter weights, suspended by cords passing over pulleys, which govern and regulate the feed.

Claim.—"All that I claim as my invention, and desire to secure by letters patent, is the vertical sliding frame, provided with cords, or ropes, and counter weights, in combination with the horizontal gate which slides in it, for the purpose and in the manner described."

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19. For an improvement in the *Lamp for Burning Camphine;* Michael B. Dyott, Philadelphia, Pennsylvania, March 18.

This patent is obtained for an improvement on, and has been added to, a patent granted on the 25th of August, 1840, and noticed in this Journal vol. ii, 3rd series, p. 263. By reference to the notice of the original patent the following claim will be fully understood, viz: "What I claim as constituting my invention is the constructing of the burner with its upper end closed, or forming a cap for the reception of the wick, without lateral openings, or joints, in the top, or cap, whilst it is at the same time capable of being removed or opened for inserting and adjusting the wick, the respective parts being formed as described."

20. For improvements in the *Machine for Making Pins;* John J. Howe, Derby, New Haven county, Connecticut, March 24.

The specification of this patent covers fifty-three folio pages, and is accompanied by numerous drawings, to which the claims refer throughout, and without which they could not be understood. A machine of this complex character does not admit of verbal description; we will merely observe that the wires are cut off, and received in carriers which are arranged radially around a wheel which successively carries them to cutters, revolving files, polishers, and other operating parts, until the pins are finished; the carriers receiving at each place the required rotary motion. The whole is arranged with much skill, and the manufacture is highly spoken of.

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21. For a *Square joint Dovetailing Machine;* William Perrin, Lowell, Massachusetts, March 24.

The nature of this "invention consists in arranging two circular cutters in such manner that they will cut the dovetails, and two other circular cutters to cut the pins to match, or fit, into the dovetails, and providing a carriage, with a slide and gauge to carry the boards to each pair of cutters."

"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the carriages one moving at right angles to the motion of the other, in combination with cutters arranged with their axles inclined, as described.

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22. For an improvement in the *Rotary Steam Engine;* Jesse Tuttle, Boston, Massachusetts, March 26.

In this engine, as in many of the old rotary engines, the chamber in which the piston works is formed by two plates, each having a semi-circular annular groove, which when put together form the chamber for the rotary piston to work in. The piston is attached to the outer edge of a plate which rotates on its axis between the two heads that form the piston chambers, commonly called the cylinder. On each side of this rotating plate is formed a cam groove, which receives a pin projecting from each side of a forked connecting rod, for the purpose of working the abutment valves. There are two of these abutment valves, placed on opposite sides of the piston chamber, with their forked connecting rods, the pins of which slide in slots made in the outer case of the engine. The steam chambers are situated on each side of the rotating plate, in which suitable appertures are made, as well as in the shaft, to conduct the steam from the side pipes to the piston. There is a sliding valve, with a handle, for changing the direction of the motion of the piston.

Claim.—"What I claim, and desire to have secured by letters patent, is the improvement of rotary engines by a combination not heretofore known; the said combination consists of the method of operating the abutment valves by means of the branched, or forked, connecting rods, having at each of their extremities a pin projecting at right angles

into the outer shell, or case, said pins working in a slot in the side of the case and operated upon by the cam upon the side of the rotating plate, as herein set forth. And the constructing of the steam chambers on each side of the rotating plate as described, connected with apertures in said rotating plate and shaft for conducting the steam to and from the piston, in combination with the side pipes and slide valves, the whole being combined, constructed and arranged as set forth."

23. For an improvement in the mode of constructing *Fire Places and Chimney Stacks;* Henry R. Sawyer, city of New York, March 26.

The claim expresses the character of this improvement with much clearness, and we shall not, therefore, offer any further description of it.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of constructing a foundation for chimneys in buildings where no chimney stack has been constructed below, by turning the arch of the hearth at its inner end, on an iron, or other metal, shoe, secured to trimmer pieces on either side, said shoe being supported on a column, or pier, which column, or pier, rests upon the sill, course, or wall, below, or foundation wall of the building, the whole being constructed and operating as described."

24. For improvements in the machine for *Excavating Ditches;* George W. Cherry, Washington, District of Columbia, March 26.

The ditch is to be excavated by means of cutters attached to the extremities of arms projecting from an inclined shaft, the arms being kept at their proper relative distances by an inclined wheel attached to them. Some of the arms are hinged so that they may be raised up when the machine is to be removed from one place to another, and this is consequently effected without the necessity of lifting the whole wheel. There are cams on the side of the inclined wheel which, as the cutter wheel revolves, strike against a lever, to communicate motion, by means of falls and ratchets, to the wheels on which the machine rests, and which consequently move it forward as the ditch is excavated. At the forward part of the machine there is a grooved wheel which runs on a rail for the purpose of guiding it.

Claim.—"What I claim as my invention and improvement, and which I wish to secure by letters patent, is, first, the manner of moving the machine forward by means of the cams attached to the arms of the inclined wheel acting on the arm attached to the vibrating axle, and by the arms and palls communicating motion to the ratchet wheels, as described; but it will be remembered that I do not claim the method of giving a forward motion to the machine simply by means of the ratchet wheels and palls, except as above limited. Second, the connexion of two or more arms to the inclined axle by means of hinges, so as to raise them from the ditch, as specified. Third, the method of guiding the machine by means of the grooved guide wheel, in combination with the movable rail track, as described."

25. For an improvement in the *Life Boat;* Joseph Francis, city of New York, March 26.

The claim is in the following words, viz: "What I claim as my invention, and wish to have secured by letters patent, is the application of air, or gas, chambers, or other agent, as a buoyant power below the line of the keel of boats and vessels, and also in the run and entrance, or end of the boat, below the keel, called sheet cylinders, in combination with the improvement in the model, forming double bottom or low bilges on each side of the keel, which I claim also separately for all boats and vessels with or without buoyant power, as set forth."

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26. For improvements in the *Rotary Steam Engine;* J. Jamieson Cardes, a citizen of the United States and now residing at Newport, England, and Edward Locke, of Newport, Monmouth county, England, March 29, 1841—patent to run 14 years from the 8th of July, 1840, the date of the English Patent.

The reader is referred to the claim which is in the following words, viz: "We, the said J. Jamieson Cardes and Edward Locke, do hereby declare that the new invention, whereof the exclusive use to be granted to us by the said letters patent, consists in the rotary engine herein before described, the distinguishing character of which is that a revolving wheel is enclosed within an exhausted box, or case, and impelled and turned rapidly round by a continual current of steam entering with force and velocity into the exhausted space wherein the wheel is situated and impinging against suitable vanes, at the circumference of such wheel, in the direction of a tangent to that circumference. The said box being connected by an eduction pipe, with a condenser which is kept cool by means of cold water, so as to exhaust the steam from the box, at that part of the circumference of the said box where the steam ceases to act against the vanes; and that condenser having an air pump capable of continual action in order to keep up the exhaustion within the common condenser."

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27. For an improved apparatus for *Regulating the Pressure of Steam and other Fluids, confined in pipes and other receptacles;* Francis R. Torbet, Paterson, Passaic county, New Jersey, March 29.

In the constructing of this apparatus one end of a balance lever is connected, by a joint link, with a sliding valve, which governs the inlet of steam, or other fluid, and the other end of said balance is connected with a piston which works in a cylinder opening into the pipe, or other receptacle, into which the steam, or other fluid, has been admitted. A sliding counter weight is attached to one end of the balance lever so that by moving it farther from, or nearer to, the fulcrum, the pressure of the steam, or other fluid, will be regulated. It will be evident that if the pressure within the pipe be too great, the piston will

be forced up in its cylinder, which, by means of the connexion with the balance lever, will partially close the sliding valve, and vice versa.

Claim.—"I do not claim as my invention any parts of the machine as new in mechanics, nor as involving a new or peculiar motion, but I do claim as my invention, and not previously known or used, the general arrangement of the machine herein described and set forth for the purpose of regulating the pressure of steam and other fluids confined in pipes and other receptacles, by means of a piston, moved by the pressure of the fluid itself, and communicating its motion to a slide valve so as to reduce the aperture through which such fluid, but under greater pressure, is admitted."

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28. For an improvement in machinery for *Manufacturing Lead and other Pipes;* Benjamin and Henry B. Tatham, Philadelphia, Pennsylvania, assignees of John and Charles Hanson, of Huddersfield, York county, England, March 29, 1841. Patent to run 14 years from the 13th of August, 1837, the date of the English Patent.

This patent is granted for certain improvements in that kind of machines in which pipes are formed by forcing the metal through an annular opening by means of a piston; but heretofore this has been done whilst the lead was in a fluid state.

Claim.—"First—The manner of making pipes or tubes of lead or other suitable metals by pressing or driving with great force the metal, while warm, though not fluid, but in a set or solid state through the apertures, arms, or divisions, of the holder or bridge," (which supports the core) "and so causing the metal to reunite around the core under the pressure after passing the bridge."

"Second—The plan of feeding the cylinder through the aperture in the upper end, or side, of the cylinder opposite the dies, and closing the aperture by the entry of the piston, in combination with the reversed arrangement of the cylinder and piston as particularly set forth, for the advantage of discharging the pipes downwards, and for the other important facilities and purposes described. Third—The conical form of the chamber between the bridge and the dies, by which the metal is constricted in its passage under the pressure. Fourth—The combination of the guide piece with the long movable core attached to the piston, in the manner and for the purpose described. Fifth—The adaptation of the improved parts by which several lengths of pipe may be made at one and the same time and operation. Lastly—The mode of constructing the piston by which the packing is forced outwards against the inside of the cylinder by the pressure of the face or end of the piston against said packing as described."

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29. For an improvement in *Propelling Boats and other Vessels;* William W. Van Loan, Catskill, Greene county, New York, March 29.

The patentee says—"In my improved mode of construction and arrangement, I so place the paddle, or propelling wheels, as that their

axes shall form an acute angle with a vertical line, say of from fifteen to thirty degrees, more or less; and their planes, of course, form a like angle with the horizon." "What I claim, therefore, as constituting my improvement, and desire to secure by letters patent, is the placing of the said wheels in the position herein made known, so that they shall enter and leave the water in a direction similar to that of oars in the ordinary process of rowing, the whole operating substantially in the manner described."

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30. For an improvement in the construction of *Wheels for Propelling Boats*, steam ships, and water and wind mills; John Hobday and William J. Cooke, Portsmouth, Virginia, March 29.

In this operation the paddle boards are to pass through openings in the periphery of a hollow drum, and are jointed to a crank within it. The crank remains stationary, but the drum is made to revolve on its axis, and in consequence of this the paddles will be projected beyond the periphery of the drum during one part of their circuit, and will be drawn in during the remainder.

Claim.—"What we claim as our invention and desire to secure by letters patent, is the introduction of a crank into a wheel, which, at the same time that it gives a new centre to the paddles, or arms, it enables them to protrude in time of action, and recede when not wanted for action, and at the same time makes the periphery of the wheel the forcing power on the arms, or paddles, and enables the constructer to make a wheel of the most powerful form."

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31. For an improvement in the machine for *Husking and Shelling Corn;* Samuel S. Allen, Miamisburg, Ohio, March 29. An improvement added to a patent granted on the 15th of January, 1840, and noticed in this Journal, vol. 1, 3rd series, page 199, to which the reader is referred.

Claim.—"What I claim as constituting my additional improvements in my machine for shelling corn, and which I desire to secure by letters patent, is the constructing my machine in such manner as that the convex posts of the frame are made to perform the office of the stationary pieces in the original machine; the movable staves, or curb pieces, being placed directly between the said posts, and these posts having the proper inclination for giving the proper form to the interior of the curb."

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32. For an improvement in the *Bee Hive;* William M. Hall, Wallingford, Connecticut, March 29. Improvement added to hive patent granted December 27, 1839, noticed in this Journal, vol. 1, 3rd series, page 107, to which the reader is referred for an explanation of the principle of the invention.

Claim.—"I do not claim as my invention the chamber with draw-

ers communicating with the hive below, nor sides adapted to cut off such communication, as they have been long known and used; but I do claim as my invention and new improvement, the direct communication between the drawers by means of corresponding orifices in each, as above specified, in combination with the right angled slides to close both orifices when a drawer is removed as above described."

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33. For an improvement in the *Counter Scales* for Druggists; Benjamin Morrison, Harrisburg, Pennsylvania, March 29.

This improvement is added to a patent granted February 16th, 1837, and noticed in this Journal, vol. xx, 2nd series, page 334, to which notice the reader is referred.

The improvement here patented constitues but a slight modification of the original scales as noticed above: and as the claims refer to the drawings, we shall omit them.

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34. For improvements in the machine for *Splitting Palm Leaf;* Carey McFarland, Barre, Worcester county, Massachusetts, March 31.

In this machine the palm leaf is split by means of grooved rollers and knives, and the waste and worthless pieces are separated from the good splints by means of two guides which carry them off. The good splints are discharged by the rollers into an inclined receiving board, and from thence into a sliding box which has a reciprocating motion that throws all the splints into a proper position for being made into bundles.

Claim.—"I do not claim as my invention the method above described of splitting palm leaf by means of the grooved rollers and knives, but what I do claim and desire to secure by letters patent is, the arrangement of the guides for separating the waste and worthless fragments of the leaf as described, and also the combination of the squaring box and receiving box for throwing all the pieces of palm leaf when split into proper position for bundling as described."

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35. For improvements in the machine for *Excavating Earth;* David C. Lockwood, New Windsor, Orange county, New York, March 31.

By means of a plough the earth to be excavated is thrown into partitions, made in an inclined wheel, and as the machine advances the earth is carried to the highest part of the inclined wheel and there discharged by lifting its inner edge which is attached to a lever. The machine runs on the lower edge of the inclined wheel, and on a small wheel, which runs within that portion of the rim of the inclined wheel which discharges the earth, so that a cart can run under this part of the inclined wheel to catch the earth discharged from it.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the within described mode of letting the dirt off from the wheel by lifting the stopboards which form the inner curb of the

periphery—and also the described arrangement by which the supporting wheel is brought within the inner edge of the upper part of the periphery of the inclined wheel, so as to allow a cart, &c., to receive the earth directly from the emptying stopboard."

Specifications of English Patents.

Specification of a patent granted to Thomas Spencer, *of Liverpool, for an Improvement, or Improvements, in the Manufacture of Picture and other Frames, and cornices; applicable also to other useful and decorative processes.* Enrolled September 8, 1841.

These improvements consist of particular applications of the new and important art to which Mr. Spencer originally gave birth, and are divided into ten heads.

The first comprehends a method of manufacturing picture frames in copper. For this purpose, a mould is made of the requisite pattern, from which a series of reverse, or intaglio, moulds are cast, in the usual manner. The cast, if not a conductor of electricity, is made one, and copper deposited upon it by the galvano-plastic process. When a sufficient thickness of copper is deposited, it is removed from the mould, and its back filled up flush with solder, and a metal rebate placed round the inside, to receive the glass or picture. The frame is then ready for gilding.

Secondly, we have a similar method of producing moulds, by the galvano-plastic process, in which composition, or papier machée, ornaments may be cast; such moulds being also applicable to glass, earthenware, and china. An exact model of the ornament or other article being produced, it is attached to a perfectly flat surface, and both being made conductors, copper is precipitated thereon by the galvanic process. The copper mould thus obtained is tinned at the back, and filled up flush with metal, in order to give it the required strength.

Thirdly, the patentee describes a mode of manufacturing obverse moulds in copper for casting therefrom ornaments, &c., in iron. Any desired pattern is rendered a conductor of electricity, and coated with copper by galvanism. In order to obtain a smooth surface at the back of the deposited copper, the cast on which the deposit is to be formed is placed horizontally in the vessel containing the cupreous solution, with its face downwards, and the copper surface which supplies the copper is placed upon the bottom of the vessel. The mould thus deposited may be used as an obverse mould for making patterns in sand for iron castings.

Fourthly, a mode of covering the surfaces of metallic picture or other frames with gold; the same process being likewise applicable to other surfaces, and to the rising or embossing of devices in gold or its alloys. For this purpose, a solution is prepared of pure gold, or of its alloys, in bromine or iodine, and to this mixture a few drops of sulphuric acid are added. The surface to be coated is cleaned in the

usual manner, and then immersed in the solution, being connected with the positive wire of a galvanic battery; a surface of gold to be eroded is connected with the negative wire, and the battery put in action, when a deposition of gold is effected of any desired thickness.

Fifthly, a mode of employing silver for covering surfaces. The solution is prepared as follows: silver is dissolved in bromine and alcohol, by means of galvanism, and this solution is allowed to precipitate a yellowish white powder; the liquid is then decanted, and the precipitate is boiled for ten minutes in thirty times its weight of a saturated solution of acetate of ammonia. Or a solution may be formed by dissolving an iodine of silver in prussiate of potassa, or any of the ammoniacal salts.

Sixthly, how metallic surfaces may be covered with platinum. For this purpose a quantity of platino-bichloride of ammonia is mixed with sixty times its weight of water, to which three parts of muriatic acid have previously been added; this mixture, after being boiled for about ten minutes, forms a solution, which is to be used in lieu of the usual solution of copper. Or bromine mixed with its bulk of alcohol is added to spongy platinum, and stirred or shaken till dissolved; this solution is then combined with half its bulk of dilute sulphuric acid, containing six times its weight of water, when it is ready for use.

If leaden surfaces are to be coated with platinum, they are cleaned by the usual method, and immersed for six hours in water containing half an ounce of either of the solutions of platinum to half a gallon of water; on its removal it will be found to have changed to a dark brown colour. If a more permanent coating be required, the lead is connected with a voltaic battery while in the solution, which should then be of double the strength. Lead so coated is applicable to surfaces used for the negative plates of galvanic batteries.

Seventhly, there is described a method of covering metallic surfaces with tin, applicable to the purposes mentioned under the fourth head. The metallic surface being thoroughly cleaned, is then placed with a surface of tin in a solution of acetate, or of muriate of ammonia, or sulphate of soda, and connected with a galvanic battery, by the action of which, tin is deposited of any thickness.

Eighthly, a mode of cleaning surfaces of iron, and then covering them with copper, by means of voltaic electricity. The iron to be cleaned is attached by a wire to the platinum end of a voltaic battery, consisting of three pairs of plates, each plate having the same quantity of surface as the iron to be operated upon; another surface of iron is attached to the zinc end of the battery, and the two surfaces immersed in a saturated solution of sulphate of soda. In a few minutes the surface will be ready to be deposited upon, when it is attached to the zinc end of a battery of three pairs of plates, and a piece of copper is connected with the platinum end of the battery; the copper and iron being immersed in a solution of copper, copper is deposited on the iron surface.

Ninthly, a method of producing enriched surfaces, applicable to picture frames, cornices, and other decorative purposes, by the use of embossed calico, paper, or other similar fabrics. The pattern being

embossed on the fabric by dies or rollers, is cut out and cemented on to the surfaces to be enriched, a coating of thick whiting being first applied to the hollow side to fill up the spaces, and give it the required strength.

Tenthly, a method of improving the texture of the composition used for casting ornaments for picture frames, cornices, and decorations, by adding to the materials usually employed for this purpose, caoutchouc dissolved in spirits of turpentine, asphalte, pyroligneous spirit, or spirit of tar, in the proportion of one pound of the caoutchouc to every six pounds of glue, used in making the composition.

The claim is, 1. To the application of voltaic electricity to the manufacture of picture and other frames.

2. To the application of voltaic electricity to the manufacture of moulds for the purposes mentioned.

3. To the application of voltaic electricity for the purpose of making patterns, or moulds, for iron founders, in copper.

4. To the use of bromine and iodine combined with gold, in conjunction with voltaic electricity, for the purposes before mentioned.

5. To the use of bromine and iodine combined with silver, in conjunction with voltaic electricity, and applicable to the surfaces mentioned under the fourth head.

6. To the use of the solution of platinum, in conjunction with voltaic electricity.

7. To the use of bromine combined with platinum, and in conjunction with voltaic electricity.

8. To the covering of lead with platinum, and applying it for the first time to the use above mentioned.

9. To the covering of the surfaces mentioned under the fourth head with tin, by the particular methods described.

10. To the method of cleaning iron surfaces, and the regulation of the quantity and intensity of electric force necessary to render iron fit to be deposited on, for the first time pointed out.

11. To the method of producing embossed or enriched surfaces on picture and other frames, and cornices, being also applicable to other interior decorations.

12. To the application of caoutchouc for the purposes before mentioned.

Mech. Mag., Oct., 1841.

Specification of a patent granted to Josiah John Guest, *of the Dowlais Iron Works, Glamorgan, and* Thomas Evans, *of the same place, for certain improvements in the Manufacture of Iron and other metals.*

The nature of this invention consists in forcing damp steam into the melted mass of metal, whatever it may be, contained in the melting furnace used for melting the said metal in, and particularly into the melted iron in refining and puddling furnaces, as also in a certain paste made with the said steam and melted cinders, and applied as hereinafter explained; and the following is a description of the man-

usual manner, and then immersed in the solution, being connected with the positive wire of a galvanic battery; a surface of gold to be eroded is connected with the negative wire, and the battery put in action, when a deposition of gold is effected of any desired thickness.

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8. To the covering of lead with platinum, and applying it for the first time to the use above mentioned.

9. To the covering of the surfaces mentioned under the fourth head with tin, by the particular methods described.

10. To the method of cleaning iron surfaces, and the regulation of the quantity and intensity of electric force necessary to render iron fit to be deposited on, for the first time pointed out.

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Mech. Mag., Oct., 1841.

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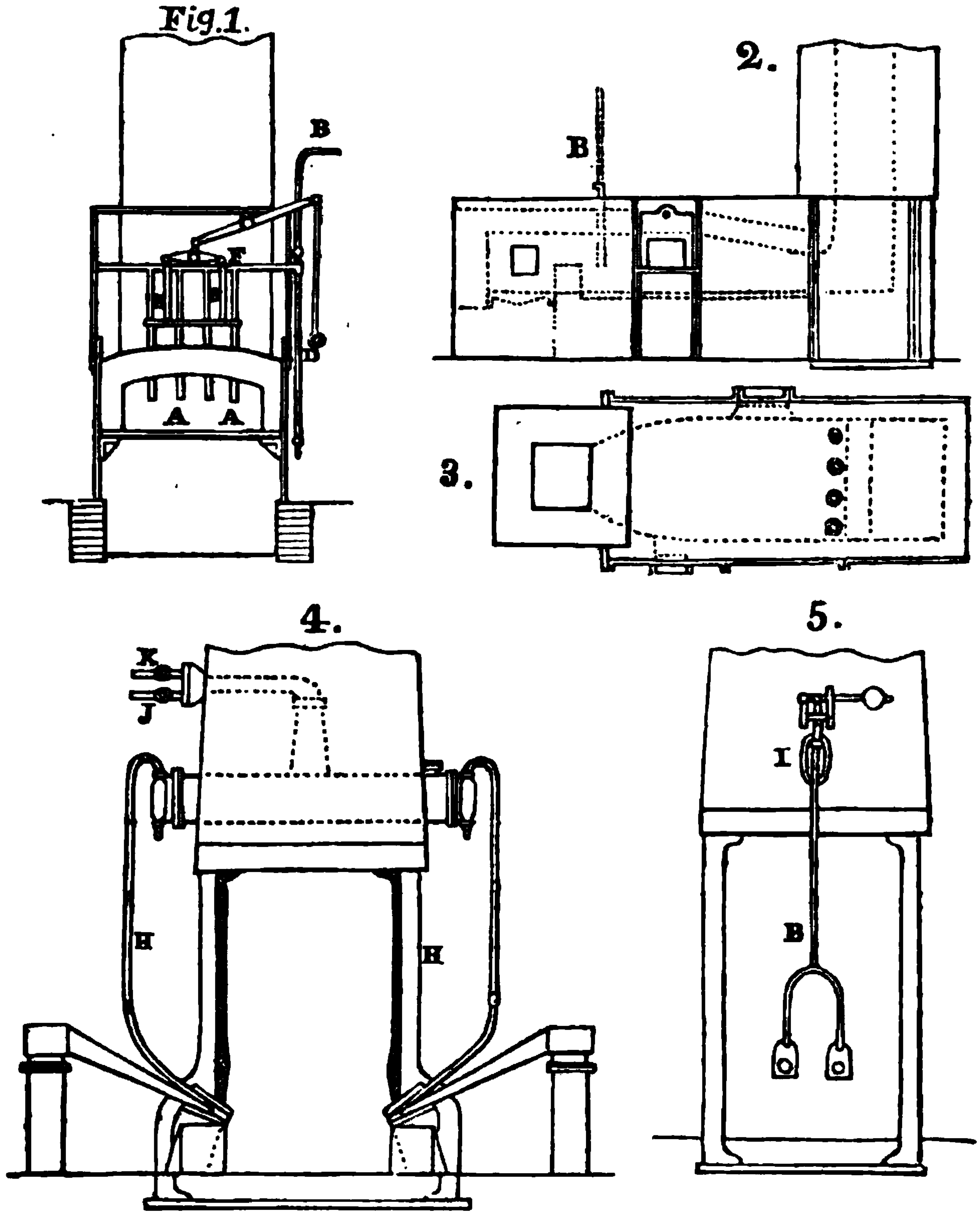
The nature of this invention consists in forcing damp steam into the melted mass of metal, whatever it may be, contained in the melting furnace used for melting the said metal in, and particularly into the melted iron in refining and puddling furnaces, as also in a certain paste made with the said steam and melted cinders, and applied as hereinafter explained; and the following is a description of the man-

ner in which the said invention is to be performed, with reference to iron, reference being had to the drawings, and to the figures and letters marked thereon:—



Description of the Drawings.

Fig. 1 represents the front elevation of a puddling furnace. A jet, or jets, of steam is, or are, introduced into this furnace, in contact with the melted iron, while in a state of what is usually called fermentation; the steam is conducted through the roof of the furnace, as here shown, through wrought iron telescope tubes, sliding one over the other, by means of which tubes we are enabled to convey the steam very near to the surface of the fluid iron to be acted upon; the success of the operation depends much on bringing the steam in close contact with the melted iron; therefore, any other plan of introducing the steam close to the iron may be found to answer the same purpose— the steam that we have used for our experiments has been supplied from the ordinary engine boiler; but, as shown in the case of the refinery furnace, fig. 4, we purpose generating the steam in the chimney of the furnace; the pressure we have used in the puddling furnace has been about fifteen pounds to the inch, through four pipes, A, A,

three-quarters of an inch in diameter, which answers very well during this process, in order to keep the sides, bridge, and bottom of the furnaces from burning. We introduce a quantity of steam upon the fluid cinders as soon as the heat is drawn until the cinders become of the consistency of paste; we then, with a rabble or rake, rake as much of that paste, and place it against the back, sides, and bridge of the furnace, as may be required, to fill any cavity that may have been burned during the previous heat of iron; the use of cinders in a state of paste for repairing the bottom and sides of the furnace keeps the iron quite clean and free from dirt, which is always found from the use of clay and limestone, as at present used. The tubes, A, A, which pass through the roof of the furnace, slide over the tubes B, B, forming thus telescope tubes, and they are raised or lowered according to the quantity of fluid metal in the furnace, by means of the lever, C, and handle, D, by which it is worked; the dotted line shows the height of the fluid metal. E is the steam pipe; F the connecting pipe, for communicating alike to all the four telescope tubes; and G is a condensed water pipe.

Fig. 2 is a side elevation.

Fig. 3 a plan of the puddling furnace.

And now, as to the refinery furnace; we introduce a jet, or jets, of damp steam, after the pig iron is melted, through the same aperture as the blast; the quantity and temperature of the steam must depend upon the quality of the pigs to be acted upon; we use four pipes of half an inch in diameter, with a pressure of twenty pounds to the inch, and find it answers our purpose; the steam is by us generated in the chimney of the refinery furnace, but it may be conveyed from the engine boilers.

Fig. 4 represents a side elevation of our steam apparatus, shown in two of the four tuyeres or apertures of a refinery furnace.

Fig. 5 is another view of it. In fig. 4, H H, are two of the steam pipes, the steam being generated in the tube, or cylinder, I, in the flue or chimney, which cylinder, I, is filled with water—J being a water feed pipe, and K a pipe on which to place a safety valve.

Now, whereas we propose to apply steam in a similar way in the melting of alloys of copper and iron, and of tin and iron, which alloys can be made in refinery and puddling furnaces by it; but in particular we apply our said invention to the manufacture of iron, whereby we obtain a better material with greater economy. And we claim as our invention the use, or application, of steam forced upon, or into, or in contact with, the melted iron, in refinery or puddling furnaces for the manufacturing of the same. And also the similar use of steam in the process of melting or manufacturing alloys of copper and iron, and of tin and iron, in such furnaces; and also the application of steam to fluid cinders, as hereinbefore described, to produce the paste aforesaid, and the use or application of the said paste, as aforesaid.—*Repertory of Patent Inventions.*

Mining Jour., Nov. 1841.

Specification of a patent granted to* William Jefferies, *of Holme street, Mile end, for improvements in obtaining Copper, Spelter, and other metals, from ores.

This invention relates, first, to a mode of obtaining copper from copper ore; and, secondly, to a method of obtaining zinc from zinc ores.

The patentee says, his improvements are confined to the smelting process, and prefers the ores to be in a raw state, instead of calcining or roasting previous to smelting; the ores may, however, be roasted or calcined previous to smelting. If this invention is to be applied to a smelting furnace, worked according to the old plan, the furnace is charged with raw or calcined ore; and when it has been well skimmed, a quantity of carbon or alkali, ground to a fine powder, is stirred into the melted mass, friable, in which state it is pushed forward to the bridge, and the heat continued until the mass is well melted; the furnace is then tapped, and the metal run off into water, leaving the slag in the furnace; then charge the furnace again, and treat the charge with carbon or alkali, as above described. It is not necessary, however, to tap or draw off the metal after each charge, as two or three charges may be added, and treated with alkali or carbon, previous to tapping. The carbon preferred by the patentee is anthracite coal or charcoal, and when alkali is used, he prefers common soda, but does not confine himself to it alone. The metal obtained by this process must subsequently be treated in the same manner as metal obtained in the ordinary way; and, as this after process is well known, it will not be necessary to give any further description.

Fig. 1. *Fig.* 2.

The second part of the invention relates to a method of smelting fine ores, and consists in carrying on the smelting process in large ovens, heated externally, by which means a large quantity of ore may be operated upon at once, at a very reduced cost, and zinc produced of most excellent quality. The description of oven and furnace employed by the patentee, is shown at fig. 1, which represents a transverse section of an apparatus, suitable for treating three or four tons of ore at the same time, instead of having a number of small vessels or retorts in a furnace. From the upper as well as the lower parts of

such oven, several small pipes, *a a*, descend into vessels, *b b*, containing water; and, as distillation proceeds, the metallic zinc will (as it becomes evaporated) pass down the pipes, *a a*, and be cooled. In constructing an oven for this purpose, the bottom and roof should be as thin as possible, so as to allow the heat to pass freely through the fire-brick, and at the same time the bottom must be strong enough to support the charge of ore. The fire-bricks, of which the oven is composed, are therefore of a peculiar form, as shown at fig. 2; and, by this means, the bottom of the oven may be made of three inch bricks, and the arch, or top, of two inch bricks.

In working, according to the improved mode, we will suppose that the oven has been at work, and is ready for a new charge; the ore is taken and mixed with about five per cent. of small bituminous coal; the oven is then charged as full as possible, and the mouth closed and luted with fire-clay; continue the fire, and distillation will proceed, as when small vessels or retorts are used, the metal passing down the pipes into the receivers as it is distilled. As there are several pipes to conduct off the distilled metal, care should be taken that none of these pipes are left open to admit atmospheric air. When the charge is worked off, the oven is opened, and the refuse or slag drawn out, and a fresh charge immediately supplied.

In conclusion, the patentee says, that although he has been particular in describing the exact means he pursues, yet he does not mean to confine himself thereto, so long as the general character of the different parts of the invention are retained. And he claims, as the first part of the invention, "the mode of smelting copper ores, by treating the melted metal with carbon or alkali, as above described; and, secondly, the mode of obtaining zinc from ores, by means of ovens, as above described." Ibid.

Specification of a Patent granted to Hugh Lee Pattinson, *of Durham, for improvements in the Manufacture of White Lead.* Enrolled September 10th, 1840.

This invention consists in the application of carbonate of lime to certain salts of lead, so as to produce a decomposition of the said salts of lead, and a reciprocal exchange of acids and bases between the carbonate of lime and the salt of lead employed. By this chemical re-action, carbonate of lead, or white lead, and a solution of lime, are obtained;—the composition of the latter depends upon the particular salt of lead made use of in the process.

The salts of lead employed, are the chloride and the nitrate; and in order to make the invention more perfectly understood, the patentee has detailed the chemical phenomena which take place when carbonate of lime and chloride of lead re-act upon each other; but, as our space is rather limited, we must pass on to a description of the practical means required to manufacture white lead, according to the improved process.

The patentee uses a mill of the following construction, to triturate

the materials of which the white lead is composed. It consists of a strong wooden tub, secured with iron hoops, the bottom of which is formed of blocks of hard stone, firmly cemented together, so as to present a level surface. Other larger blocks, of the same kind of stone, are carried round upon this bed, by machinery, so that any hard and brittle substances, when placed in the tub with water, are continually rubbed under it, until reduced to the finest powder.

This description of mill is employed, because it continually mixes, and rubs together, the materials submitted to its action. Care should be taken that no iron, employed in the construction of the mill, may be so situated as to be liable to act upon the bodies to be ground; and where metallic fastenings are required, copper may be used. Into a mill of this kind, twelve feet in diameter, and three feet deep, put twenty-one hundred weight of chloride of lead, and seven and a half hundred weight of carbonate of lime, in the form of the best washed chalk or whiting; then partly fill the tub with water, and put the mill in motion. After the materials have been ground from four to six hours, cease grinding, and add more water, until the tub is nearly full; then suffer the whole to stand till the next morning, when a white mass, consisting of carbonate of lead, mixed with undecomposed carbonate of lime and chloride of lead, will be found at the bottom of the tub, and above this, a clear liquor, which is a strong solution of chloride of calcium, nearly free from lead. This solution must be drawn off, by means of a syphon or plug, and as much fresh water added as the tub will conveniently hold; then the grinding is renewed for a few hours; and when stopped, the materials are allowed to settle as before, and the solution again drawn off, and fresh water added, the grinding being continued again for a few more hours. The process is continued, day after day, in this manner, the supernatant liquor becoming every day a weaker solution of calcium, nearly free from lead, until at the end of seven or fourteen days it is nearly tasteless, when the decomposition is considered to be complete, and the white mass, at the bottom of the tub, will have become very nearly a pure carbonate of lead; in which state it is removed from the tub, and dried and prepared for the market in the usual manner.

When the patentee uses water, impregnated with carbonic acid gas, instead of grinding the materials together, as above described, he employs the following apparatus:—

A barrel, made of lead, wood, or copper, strongly hooped with iron, and of any convenient size, is mounted on gudgeons; to one of which, a fast and a loose pulley are connected, and rotary motion is communicated thereto from machinery, by means of a band. The other gudgeon is made hollow, and communicates with the interior of the barrel; it is also furnished with a stop-cock, and, by means of a screw-joint, may be connected to a force-pump, for the purpose of forcing carbonic acid gas into the barrel.

One hundred and forty pounds of chloride of lead, and fifty pounds of carbonate of lime, are introduced into the barrel, through an aperture made in the end thereof; then the barrel is nearly filled with pure water, and the aperture is closed by means of a screw-plate and

leather washer. Carbonic acid gas is then forced into the barrel, by means of the force-pump, until the water is saturated under a pressure of four or five atmospheres; after which, the barrel is made to revolve at the rate of twenty revolutions per minute, and the substances within immediately begin to act upon each other; the carbonic acid solution dissolving the carbonate of lime, and presenting it to the chloride of lead in a better form for decomposition than when solid, or nearly so. This operation is carried on for three or four days; at the expiration of which, the action has advanced so far, that very little chloride of lead, or carbonate of lime remains, and the liquid is a strong solution of chloride of calcium, which, when the insoluble mass is settled, may be removed from the barrel in any convenient manner, and a further quantity of water, impregnated with carbonic acid, must be added, and the barrel set in motion for a day or two longer, until the decomposition is perfected.

When nitrate of lead is used the same process is adopted with the chloride, except that the exact chemical equivalent of the two substances is employed. In the grinding tub, twenty-four hundred weight and nine-tenths of nitrate of lead, and seven and a half hundred weight of carbonate of lime, are ground together; and in the barrel, one hundred and sixty-six pounds of nitrate of lead, and fifty pounds of carbonate of lime are introduced. In both cases, the two substances are allowed to re-act upon each other, until the decomposition is complete; after which the carbonate of lead is removed, and prepared for sale.

Lond. Jour. Arts & Sci.

Specification of a patent granted to John Henry Le Keux, *of Pentonville, for an Improvement in Line Engraving, and in producing impressions therefrom.*

This improvement consists in engraving a subject on two plates, one portion of the subject on one plate, and the remainder on the other, so that when printed, the combination of the two impressions shall produce the effect required.

Two plates being prepared for engraving, on one of them is put a tracing of any given subject. The outline and dark shadows are then etched on this plate, and finished by the usual process of line engraving; this plate is called the subject plate.

A tracing, or transfer, from the above is then placed on the other plate, and a tint of lines is ruled all over the subject; the lights are then stopped out, and the under tints, or shadows, are produced by biting in; thus forming what is called the ground plate. The plates being marked with register lines are printed, one upon the impression of the other, so as to produce the effect sought.

The claim is to the ruling of a tint of lines, and then producing the required under tints, lights, or deep shadows, on a separate plate from that on which the general subject is engraved, and then taking impressions from the two plates so engraved in the manner described (both being engraved in the style called line engraving,) whereby an entirely novel effect is produced, with a considerable saving of labour.

Mech. Mag. Sept., 1841.

until a slight putrescence is apparent, when they are removed to suitable vessels, and covered with water, into which is poured from 6 to 28 or 30 lbs. of hydrochloric acid from each cwt. of animal substance. The vessel is then covered over, and the skins left to the action of the acidulated water from eight to twenty-four hours, or until the skins assume a white semi-transparent appearance, when they are taken out and thoroughly washed in cold water, and afterwards deposited for two or three days in a tank, through which a current of fresh water flows continually. Instead of the hydrochloric acid in solution, the skins may be treated with hydrochloric acid gas. Hides, &c., are subjected to the above processes, and then tanned in the ordinary way.

The claim is to the use of a rotating, perforated, or other, cylinder, for the purpose of unhairing the skins, hides, or pieces, to be used in the manufacture of gelatine, size, or glue; when used in combination with a solution of lime, potass, or soda, or combined portions of either. Also, the application of hydrochloric acid, or hydrochloric acid gas, or either of them diffused in water, in whatever manner they may be employed; when applied to hides, skins, or other animal substances, for the purpose of preparing them for the manufacture of gelatine, size, or glue. Also the sole application of the above mentioned acid and acid gas to hides and skins, for the purpose of preparing them for being tanned.

Ibid.

METEOROLOGICAL OBSERVATIONS FOR MARCH, 1842.

Moon.	Days.	Therm. Sun Rise.	Barometr.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	40°		SE. SW.	Moderate		Cloudy.	Flying clouds.
	2	38		SE. SW.	do	.08	Drizzle.	Drizzle.
☽	3	50		W.	do		Clear.	Clear.
	4	54		SW NW.	do	.15	Par. Cloudy.	Thunder shower.
	5	59		W.	Brisk		Clear.	Flying clouds.
	6	43		E.	Moderate		Cloudy.	Cloudy.
	7	42		W. NW.	do	.31	Cloudy.	Rain.
	8	31		SW.	do		Clear.	Clear.
	[illegible]	40		SW.	do	.24	Cloudy.	Rain.
	10	57		SW.	do	.12	Cloudy.	Cloudy, rain.
	11	41		NE. NW.	[illegible]		Cloudy.	Partially cloudy.
⊗	12	23		NW.	do	.02	Clear.	Clear, snow in night.
	13	32		SE. W.	[illegible]		Cloudy.	Cloudy.
	14	36		W. SE.	do		Cloudy.	Cloudy.
	15	34		W.	do	.08	Clear.	Cl'dy. thunder sh'r.
	16	32		SW.	do		Clear.	Partially cloudy.
	17	40		SW.	[illegible]		Cloudy.	Cloudy.
	19	[illegible]		NW.	do	.37	Clear.	Lightly cl'dy, th.sh'r.
☾	19	40		SE. W.	do		Par. Cloudy.	Hazy.
	20	56		SW.	do	.14	Cloudy.	Lightly cl'dy, th.sh'r.
	21	38		NE.	do		Par. cloudy.	Cloudy.
	22	34		NE.	do		Rain.	Cloudy.
	23	33		E.	do		Cloudy.	Cloudy.
	24	35		[illegible]	do		Cloudy.	Cloudy.
	25	[illegible]		E.	do	.55	Rain.	Cloudy.
☉	26	40		W.	Brisk.		Cloudy.	Flying Clouds.
	27	[illegible]		W.	do		Clear.	Clear.
	29	41		NW.	Blust'ring		Clear.	Flying clouds.
	29	31		W.	Moderate		Clear.	Clear.
	30	[illegible]		SW.	do		Par. cloudy.	Cloudy.
	31	45		NW.	Brisk.		Clear.	Flying clouds.
		40.13				1.96		

Thermometer.		Barometer.	
Maximum 71.00 on 3rd. Minimum 23.00 on 12th.	Mean, 46.18.	Max. 30.36 on 12th. Min. 29.50 on 2nd.	Mean 29.9[illegible]

M Barome...

Collated f... ology o... vania, ...

	C...	9, P. M.	Maximum.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
1	Phila	.12	30.	⅓	6⅓	1⅓	.	9⅓	....	.	.....	....	..	1750
2	Mont													
3	Buck	.04	30.	1⅓	12⅓	⅓	.	⅔	....	.	.....	....	..	1613
4	Lehi													
5	Nort													
6	Mon													
7	Pike,													
8	Way													
9	Susq	.02	28.3	.	11⅓	⅔	.	.	....	.	.....	....	..	1624
10	Luz													
11	Schu	36	29.6	1⅔	3⅓	.	10	5⅔	....	.	.....	....	..	1628
12	Ber													
13	Che													
14	Del	46	29.8	.	.	.	.	.	....	.	.....	57.72	17	1610
15	Lan	51	29.9	2⅔	3⅔	2⅔	.	⅔	42.39	1	.....	50.39	1	1643
16	Yor													
17	Leb													
18	Dau	75	30.1	.	11	.	.	⅓	....	.	.....	....	..	1602
19	No	47	29.8	.	4⅓	.	5⅔	.	....	.	.....	53.23	1	1612
20	Co													
21	Bra													
22	Ti													
23	Ly													
24	Un													
25	Mi													
26	Ju	3	29.9⅔	.	5⅓	.	14⅓	5	....	.	.....	....	..	1609
27	P													
28	Cu	4	29.8⅔	⅔	7⅓	1	6⅓	.	....	.	.....	....	..	1618
29	A	2	29.7⅔	1⅓	8⅓	1	.	.	42.12	.	.....	48.21	..	1654
30	F													
31	H	8	29.7	.	.	.	.	⅓	....	.	.....	....	..	1629
32	C	8	29.9.	.	4⅓	.	.	9⅓	....	.	.....	....	..	1611
33	P													
34	M													
35	C													
36	C	5	28.1	.	8⅔	.	.	4⅔	....	.	.....	....	..	1614
37	H	4	29.5⅓	8⅓	7⅓	.	.	⅔	....	.	.. .	....	..	1616
38	S	5	28.0	1⅓	1	.	8⅔	9⅔	....	.	.....	48.24	10	1621
39	I													
40	J	2	29.3	.	.	.	.	.	....	.	.....	....	..	1626
41	V													
42	V		29.34	.	22⅔	..	.	⅔	....	.	.....	....	..	1737
43	A													
44	V													
45	I													
46	C													
47	V													
48														
49			29.50⅔	.	8⅔	1	9⅔	3⅔	....	.	.....	....	..	1615
50														
51			29.10⅓	.	1⅔	.	.	.	....	.	.....	....	..	1622
52														
53			29.05 ⅔	.	1⅔	.	12⅓	⅔	....	.	.....	....	..	1617

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2
2
3
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Maxi
Minin

	mete								Hygrometer.					
Collat ology vani		Maximum.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
1	Phil	0.58	5⅓	⅓	4	1⅓	.	7⅓	....	.	.....	....	..	1782
2	Mo													
3	Bu	0.48	3⅔	1⅔	9⅔	.	.	2	....	.	.....	....	..	1718
4	Leh													
5	Nor													
6	Mon	9.88	3	.	⅔	.	.	23⅓	....	.	.....	....	..	1651
7	Pik													
8	Wa													
9	Sus	8.30	5⅓	.	8⅓	.	.	.	....	.	.....	....	..	1652
10	Lu													
11	Sch	9.73	4	.	6	.	7⅓	1⅓	....	.	.....	....	..	1667
12	Ber													
13	Che													
14	Del	9.94	3	⅓	⅔	1	⅓	16⅓	....	.	.....	....	..	1642
15	Lan	9.96	3	4⅓	1⅓	1⅔	.	⅓	37.26	1	.....	42.76	1	1657
16	Yor													
17	Leb													
18	Dau	0.17	4⅔	.	14⅔	.	.	⅓	....	.	.....	....	..	1630
19	Nor	9.88	6⅓	⅓	4	⅓	2⅔	.	....	.	.....	....	..	1631
20	Col													
21	Bra													
22	Tio													
23	Lyc													
24	Uni													
25	Miff													
26	Juni													
27	Perr													
28	Cum	29.82	3	.	8⅔	.	6⅓	1⅓	....	.	.....	....	..	1649
29	Adam	29.74	6⅓	2	3⅔	1	3⅓	⅔	35.47	8	.....	42.94	7	1655
30	Fran													
31	Hun	29.73	20⅔	.	.	.	.	1	....	.	.....	....	..	1656
32	Cent	29.69	6⅔	.	9⅔	.	.	2⅓	....	.	.....	....	..	1640
33	Potte													
34	M'K													
35	Clea													
36	Cam	28.10	13	⅔	4⅓	.	⅓	2⅓	....	.	.....	....	..	1647
37	Bedf	29.55	1⅔	7	6⅓	.	.	⅓	....	.	.. .	....	..	1632
38	Som													
39	India													
40	Jeffe	29.20	.	.	.	.	.	.	....	.	.....	....	..	1658
41	War													
42	Vena	29.60	.	.	15⅔	.	.	.	....	.	.....	....	..	1646
43	Arm													
44	West													
45	Faye													
46	Gree													
47	Wash													
48	Alleg	29.52	2	1⅔	7⅓	.	10⅓	1	....	.	.....	....	..	1637
49	Beav													
50	Butl	29.10	12⅔	.	.	.	.	.	....	.	.....	....	..	1644
51	Merc													
52	Craw	29.05	4	.	⅓	.	9⅓	1	....	.	.....	...	..	1641
53	Erie,													

ADDRESS

OF THE

COMMITTEE ON PREMIUMS

AND

EXHIBITIONS

OF THE

Franklin Institute of the State of Pennsylvania,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

The Franklin Institute, the pioneer in Domestic Exhibitions, has, by example furnished to sister institutions, as well as by its own exertions, shown the immense benefits which result from them.

Eleven Exhibitions of American Manufactures have been held by this Institution, commencing in 1824; and the progressive improvements which have been manifest to those who have watched them, give sufficient evidence of the great importance to the producers, of frequent opportunities to display the fabrics of different manufactories, from the various sections of the country.

Not only are the producers made acquainted with the improvements in their respective arts, but the consumers are brought in close contact with them, and thousands have convincing proof, that all the wants of life may be supplied within the resources of our common country.

A moment like this, when the whole industry of the country is paralysed, and thousands of citizens are seeking in vain for work in their respective callings, seems auspicious for the American manufacturers to make some exertions to show their fellow-citizens, who will throng our city during the autumn, that they are fully capable of furnishing any manufactured product that may be required in the economy of life; and give them ocular demonstration that they need no longer impoverish the country, by supplying themselves with the products of the foreign workshops.

The prosperity of the mechanics of the United States has been seriously affected by excess of importations, and it needs but the stimulus of our renewed exhibitions to arouse that patriotic spirit which has already dawned on our countrymen, to rally them round the American Standard, and free them from the shackles of the foreign mechanic.

The Institute does not deem it advisable to offer any specific premiums, or to enumerate the various specimens of art which ought to find a place in their Hall. The object of the Institute is to foster and promote manufactures, and space will be furnished for a fair display of every specimen that may be offered.

Premiums will be awarded by competent and impartial judges, to such as shall excel, and be found worthy of them, under the rules and regulations which are herewith appended.

The mechanics and manufacturers are invited from all parts of the United States, to contribute specimens of their productions.

SAMUEL V. MERRICK,
JOHN C. CRESSON,
ALEX. DALLAS BACHE,
THOMAS FLETCHER,
JOHN STRUTHERS,
JOHN S. WARNER,
SOLOMON W. ROBERTS,
Committee on Premiums and Exhibitions.

Published by order of the Board of Managers.

FREDERICK FRALEY, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

Philadelphia, May 23d, 1842.

REGULATIONS

Of the Twelfth Exhibition of Domestic Manufactures, to be held in the City of Philadelphia, from the 18*th to the* 29*th day inclusive, of October,* 1842.

1. The exhibition room will be prepared to receive the goods on Saturday, the 15th of October, and opened for the admission of visiters on Tuesday, the 18th of October, at 10 o'clock, A.M.

2. All goods intended for competition must be deposited before 12 o'clock (noon) on Tuesday, the 18th of October.

3. To insure a perfect impartiality, the Managers of the Institute, the Committee on Premiums and Exhibitions, and all firms or partnerships in which a Manager, or a Member of the Committee on Premiums and Exhibitions, is interested, shall be excluded from competition; and no Committee shall award a premium or compliment to any of its members.

4. No premium shall be awarded for an article that has received one at any other public exhibition; and none shall receive a premium that is not equal in quality to the best articles of similar manufacture, presented at former exhibitions.

5. Proof of origin must be furnished, if required, for every specimen offered for exhibition.

6. All articles deposited must be accompanied by an invoice, stating the names and residences of the makers and depositors.

7. Arrangements will be made to exhibit to advantage any working models that may be sent in for exhibition, and the Managers respectfully invite contributions in this branch. Experience has shown the interest which the public take in them; and the Managers are impressed with a conviction that the display of them is calculated to convey useful information. A careful and competent superintendant will be provided.

8. The mornings of each day, until fifteen minutes before ten o'clock, shall be appropriated to the Judges.

9. Neither owners nor depositors of goods shall be admitted to the exhibition room during the time appropriated to the Judges, except at the special request of the Judges of the articles owned or deposited by them.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

JUNE, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

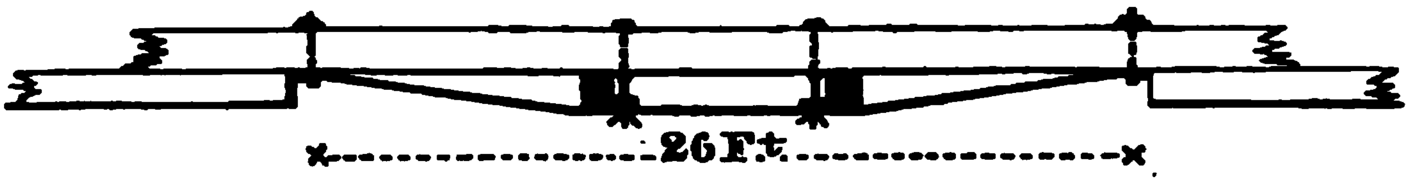
Details of some Experiments upon the Comparative Strength of Trussed and plain girders of wood, made at the Philadelphia Exchange, during the construction of that building in 1832. *By* MR. JOHN MCCLURE and ELLWOOD MORRIS, C. E. *Reported by the latter.*

The experiments which have been made upon the relative strength of girders, trussed and untrussed, are so few—that the following details may be found interesting to persons engaged in construction; particularly as the mode of trussing by suspension, therein tested, is becoming more and more extensively used in this country, and is really susceptible of being made very serviceable in many situations.

These experiments were undertaken with the view of ascertaining the proximate value of wrought iron suspension trusses for girders, which were about that time brought forward conspicuously here, as a new and useful improvement in carpentry; though at least in one instance they had been used many years before in this country; viz., by Lewis Wernwag, the celebrated carpenter,* who applied suspension bars, one and a quarter inches square, to stiffen the main longitudinal floor beams of the bridge over the Neshaminy creek, in this state, which was built by him in the year 1808. (See the annexed sketch

* Mr. Wernwag, a German by birth, immigrated here in 1788, and is the same mechanic who designed and constructed the famous timber bridge of 340 feet span, over the Schuylkill river at Philadelphia, (recently destroyed by fire,) besides many other wooden bridges of magnitude and importance, in various parts of the United States.

which represents a side view of the suspension truss used in the bridge referred to.)



We have taken the pains to ascertain from Mr. Wernwag himself, the date of the construction of the Neshaminy bridge, as it carries the application of the suspension girder truss somewhat further back into past time, than has heretofore been expected; though the writer has lately been informed by a gentleman distinguished for his antiquarian researches, that such trusses were in use upon the continent of Europe even antecedent to that time.

The now recorded history of the wrought iron suspension truss for girders, as far as known to the writer, is as follows:—"In 1821, Mr. R. Stevenson, of Edinburgh, designed a bridge for the river Almond, in which the principle of supporting a roadway by iron bars passing underneath, was first adopted."* In 1822 the same principle was recommended by Mr. H. Palmer, to be applied in carrying his railway, of a single line, over streams or vallies.† In 1824 Mr. A. Ainger submitted a suspension trussed girder to the Society for the encouragement of Arts;‡ to which we shall presently more particularly refer, and which was successfully applied to practice. In 1828 girders trussed by suspending rods were used with manifest advantage in several buildings, by Mr. Joseph Conder, who claimed the merit of their invention, as did also Mr. A. H. Renton, Civil Engineer.‖ All these gentlemen, however, without their knowledge, had been anticipated in this matter by Wernwag, at the Neshaminy bridge, as before mentioned.

In addition to the above, the writer may state that in 1833 he examined a wrought iron suspension truss, which had been applied some years before, on a large scale, to uphold the central parts of Flat Rock bridge, (of 198 feet span,) over the Schuylkill river; which bridge—constructed with *very slender* curved ribs of three inch plank—had at that time yielded considerably, and since has fallen down. In 1834 he measured a horse bridge (built by Wernwag) upon the Chesapeake and Ohio Canal, near Harper's Ferry, of 52 feet span, which was trussed like fig. 1, the horizontal bar being 26 inches clear of the underside of the outer floor beams, which rested each upon two inverted queen posts of iron, diagonally braced against lateral motion,

* Civ. Eng. & Arch. Jour., for Oct., 1841. "Description of the Foot Bridge over the river Whitadder, at Abbey St. Bathans, Berwickshire; by J. R. Wilson."

† Palmer's "Description of a railway on a new principle," London.

‡ Journal of the Franklin Institute for 1832. ‖ Reg. of Arts, 2nd series, vol. ii, London.

and rising, as it were, from the angular points *b* and *c*. This species of truss has, since that time, been applied to strengthen the girders of a number of bridges in this country, to which it is unnecessary now to refer.*

Returning from this digression, into the recent history of suspension trussing; we will now repeat, that in this Journal for August, 1832, the description of a mode of trussing girders with wrought iron rods, acting upon the suspension principle, was extracted from the "Transactions of the Society for the encouragement of Arts," and accompanied by two wood engravings.

The plan alluded to was devised by Mr. Alfred Ainger, and submitted to the Society in 1824, who after investigating the merits of the plan—trying some experiments upon models—and witnessing its successful application in buildings—finally testified to Mr. Ainger, their sense of the merit of his contrivance for strengthening beams, by formally awarding to him the thanks of the Society.

Mr. Ainger's suspension truss, as applied to a girder of 34 feet span, and described in this Journal for 1832, consisted of two sets of iron rods, (one on each side of a single beam of timber,) secured by screws and nuts, to abutment plates, notched upon *the upper side* at the ends; these rods descended so low as to admit of two supporting plates being inserted between them and the beam, and forced up against its underside by the end screws, so as to give to the girder two intermediate points of support; thus dividing the whole span into three bearing spaces of equal extent; the side view closely resembling fig. 1.

This girder is described as having answered very well, it is stated to have carried a leaden flat for two years, without sensibly altering its form.

Mr. Ainger also recommended that notches should be cut in the upper side of the beam extending to one-third of its depth, and filled "with thin wedges of hard wood or metal, forcibly driven in," so as to augment its strength and stiffness, by putting its upper side in a state of compression before being loaded.†

* In connexion with this branch of the subject, we must not omit to add the following, from the same paper of Mr. J. R. Wilson, (Civ. Eng. & Arch. Jour., Oct, 1841,) already quoted.

"In 1833 a bridge was erected on the tension bar principle over an arm of the lake of Geneva. It has 13 openings, of 55 feet span, and is 25 feet broad. The same plan has been adopted for two foot bridges of 138 and 81 feet span respectively, erected several years since over the river Ness, near Inverness; and also for a bridge over the river Whitadder, in Berwickshire, at Hutton Mill, designed by Mr. Jardine, of Edinburgh, which consists of three openings of 50 feet span. Mr. Smith, of Deanston, has erected a foot bridge of this kind, 103 feet span, near Doune: and has also applied tension rods very successfully, for supporting the floors of Deanston cotton works, where they have been in use for many years."

† This was conformable to the results of some experiment by M. Duhamel, who showed

It was the article above referred to which first drew the attention of the writer to this particular subject, and induced him, in company with Mr. McClure, to undertake, in the year 1832, a few experiments upon model girders.

These models were accurately made under the direction of Mr. McClure, and were *five in number;* each was composed of two parts, or flitches, so united as to bear a strain together; each side, or flitch, was 53 inches long, 1.75 inches deep, and 1.16 inches broad, having together a sectional area of 4.06 superficial inches; and all the models were made of clean, straight grained, and well seasoned *white pine;** number 1, 2, and 3, were from the same plank, and Nos. 4 and 5 from timber of the same lot and quality.

Model No. 1: Was trussed in a mode similar to that prescribed by Mr. Ainger; a single wrought iron rod exactly one-fourth of an inch square, being secured upon the upper side, at both ends, by quarter inch square pins, resting horizontally upon abutment plates one-twelfth of an inch thick, which embraced each end of the girder; this rod descended between the flitches so low as to admit the insertion of two bearing plates, *b* and *c*, fig. 1, which were forced in between it and the underside of the beams, at equal distances from the ends, and from each other, so as to give to the girder a small camber. (See plan and section, fig 1.) And, in addition, 34 equidistant cuts were made in this model, to a depth of one-third of the whole, and tightly filled with thin pieces of hard oak well driven in.

Model No. 2: Was similar to No. 1, (fig. 1,) in all respects except that the hard oak wedges were *omitted.*

Model No. 3: Was a plain stick, formed by nailing the two flitches

that when a bar of *soft wood,* such as willow, was cut one third through from the upper side, and this cut filled with a thin piece of *hard wood* stuck in pretty tight, *its ultimate transverse strength was thereby increased about ten per cent.,* (Barlow's Essay on the Strength and Stress of Timber, 3rd Ed., 1826.)

* This is the *Pinus Strobus* of Michaux's North American Sylva (vol. iii, p. 159)—the loftiest tree of the American forest—it is employed here for an immense variety of purposes, and is one of the most valuable timbers which we possess.

It is the wood called *Weymouth Pine,* in Tredgold's Carpentry; and we may here remark that the concurrence of three of our experiments indicates that the ultimate strength of the white pine, used in our models—which was of the best quality supplied by the lumber market of Philadelphia—did not exceed 868 lbs., for sticks of the scantling, and length of bearing, used by us.

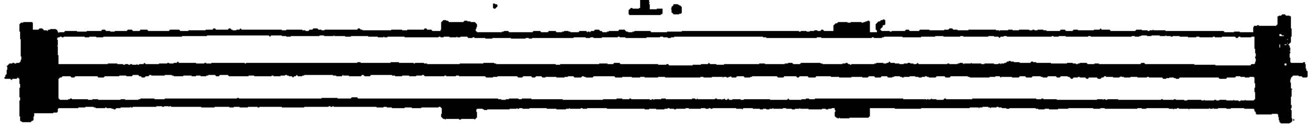
Wherefore the constant quantity *c*, of the table in Tredgold's Carpentry, (2nd Ed., London, 1828, p. 56,) calculated by the formula $c = \frac{W\,L}{b\,d^2}$ would be 509 instead of 658, as Tredgold has it, which last is certainly too high a number; for the breaking weight of our plain stick, (model No. 3,) if calculated by it, would have been 1,122 lbs., instead of 868 lbs., (as we actually found it to be,) *or thirty per cent. more.*

together, side by side, with four nails in the centre line, (see fig. 2, side view.)

Model No. 4: Was a girder trussed exactly like Nos. 1 and 2, except that *a central bearing plate,* one-sixteenth of an inch thick, was inserted between the beam and truss rod at *a*, fig 1.

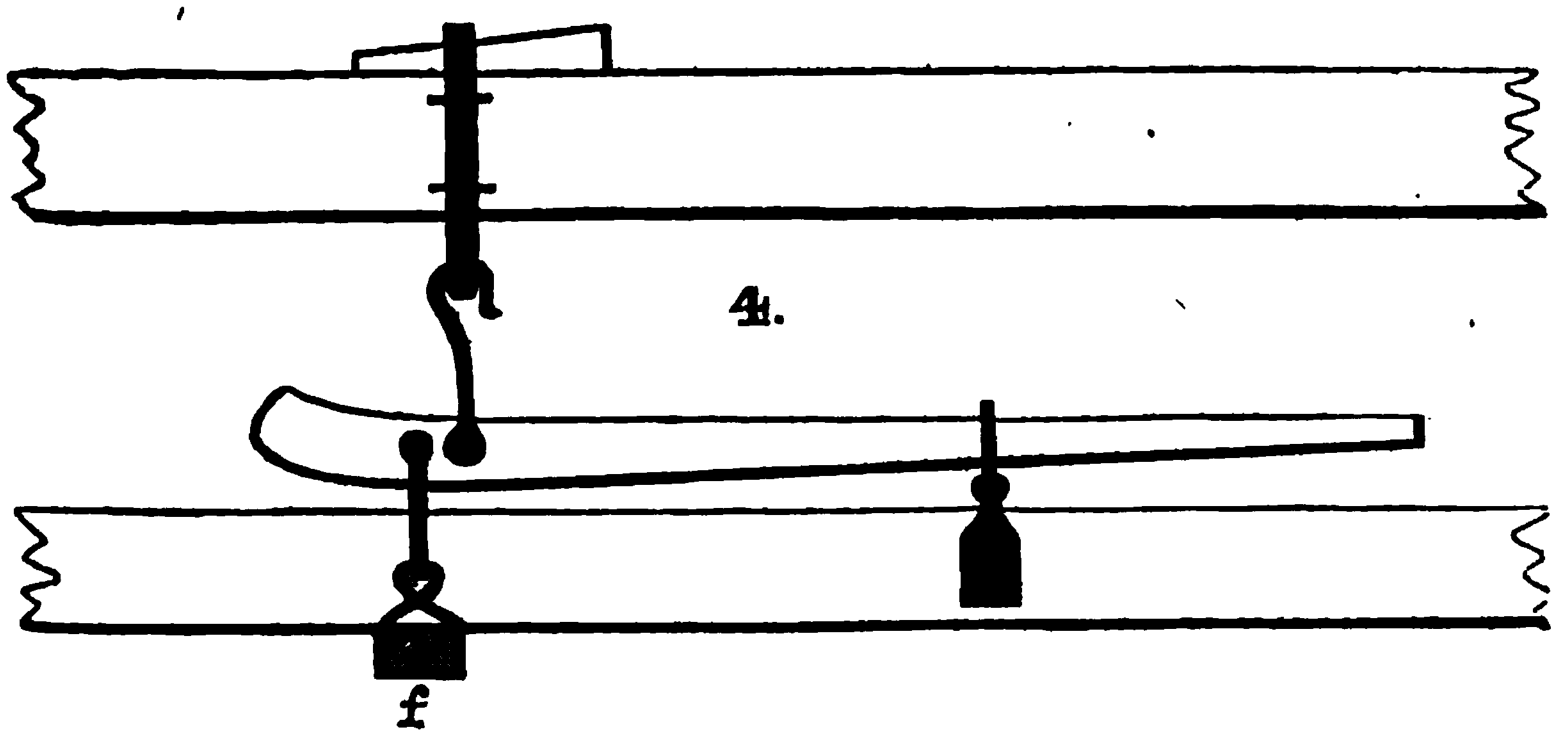
Model No. 5: Was a girder trussed in the common way—with one king bolt, two iron abutments, two hard oak braces let into each flitch nearly one eighth of an inch—and keyed up to a slight camber. (See fig. 3, which shows the girder with one flitch removed.)

1.



2.

3.



All of these models were put under strain in the same manner, their own weight being counterbalanced; viz., by resting them against two fixed supports, exactly 50 inches asunder, and applying the straining force, by a vertical pull upwards, through an iron stirrup with rounded edges, slipped over the model—which was turned bottom up—and attached to the shorter arm of an accurate steelyard, which weighed up to 1,288 lbs.; and the successive strains were put on by moving the pea of the steelyard, as in weighing, so as to add usually 56 lbs.

at a time; the beam of the steelyard being adjusted to a level at each addition of strain, and the deflections being carefully measured—from a fine string joining the extremities of the models—by a diagonal scale to hundredths of inches. (See fig. 4, which gives a general idea of the experimental apparatus, *f* being a girder under trial.)

The subjoined tabular statement exhibits, at one view, the results of the trials of the strength of the several model girders; which it will be recollected, were all of precisely the same scantling and bearing length.

It must be observed that our steelyard not having sufficient power to break model No. 4, it was subsequently broken by a lever, in order to ascertain the position of *the neutral axis of fracture.*

The five following results were common to all the models when broken, and though similar to what have been observed by other experimentalists, they may as well be stated.

1. *The neutral axis of fracture*, occupied precisely the same place

Statements.	Weight applied in pounds.	Girder No. 1. Trussed with iron rod, and wedged along compressed side. See fig. 1.		Girder No. 2. Trussed with iron rod, but without the wedges of No. 1. See fig. 1.		Girder No. 3. Plain stick without trusses. See fig. 2.	
		Deflection in inches.	Remarks.	Deflection in inches.	Remarks.	Deflection in inches.	Remarks.
1	56	c.20	Original camber .31ins	c.15	Original camber .20ins	.09	Original camber .0 ins.
2	112	c.06	Stood level with 140lbs	c.09	Cambers marked c.	.16	
3	168	.09		.00	Stood level with 168lbs	.27	
4	224	.22		.04		.37	
5	280	.40		.12		.47	
6	336	.55	364 lbs. remaining on for 10 minutes, increased the deflection .12 ins.	.19		.57	
7	392	.80		.28		.65	
8	448	.94	At 8 unloaded returned to a camber of .10.	.37		.75	
9	504	1.13		.47	At 9 unloaded returned to a camber of .12ins	.83	At 9 unloaded returned to level.
10	560	1.40	532 lbs. remaining on 5 minutes increased the deflection from 1.27 to 1.32 = 0.15 ins.	.64		.93	Ditto.
11	616	1.68	At 11 unloaded returned to a deflection of .18 ins.	.77		1.07	
12	672	1.98		.89	Upper fibres begin to crush.	1.19	Upper fibres begin to crush.
13	728	2.21		1.00		1.35	
14	784	2.50		1.20	Appearance of crushing extends rapidly.	1.51	Crushing fast increased.
15	840	2.80		1.50		1.76	
16	868	3.00	Broke with 868lbs. (or 7 cwt. 3 qrs.) ultimate deflection 3 inches.	1.75	Broke with 868lbs. (or 7 cwt. 3 qrs.) ultimate deflection 1¾ inches.	2.50	Broke with 868lbs. (or 7 cwt. 3 qrs.) ultimate deflection 2½ inches.
17	896						
18	952						
19	1008						
20	1064						
21	1120						
22	1176						
23	1232						
24	1288						

in all, being at four-sevenths of the whole depth down from the top, or one fourteenth below the middle, (Barlow's experiments on *fir beams* fixed it at five-eighths of the depth, which is nearly the same.)

Giving, area of fibres *crushed*,	2.32	square inches.
Ditto *torn asunder*	1.74	"
Total sectional area in superficial inches	4.06	

2. The first indications of fracture, always appeared on the upper side, by the fibres *crushing*.

3. The signs of crushing at the time of fracture could be traced each way from the centre some five or six inches.

4. The deflections within the limit of elasticity, were (very nearly) equally increased by the addition of equal weights.

5. The place of the neutral axis of fracture, was most distinctly marked in every case, and the section of fracture, in all the models,

Statements.	Weight applied in pounds.	Girder No. 4. Trussed like Nos. 1 and 2, but with the addition of a *centre plate* at *a*. See fig. 1.		Girder No. 5. Trussed with wood in the common way. See fig. 3.	
		Deflection in inches.	Remarks.	Deflection in inches.	Remarks.
1	56	c.14	Original camber .19 inches.	.05	Original camber .05 inches.
2	112	c.09	Cambers marked c.	.10	Stood level with 28 lbs.
3	168	c.05		.17	
4	224	.00	Stood level with 224 lbs.	.25	
5	280	.04		.32	
6	336	.08		.41	
7	392	.14		.47	
8	448	.21		.55	
9	504	.29	At 9 unloaded returned to the ori-	.64	
10	560	.37	ginal camber.	.71	
11	616	.46		.79	At 11 unloaded returned to level.
12	672	.53		.95	
13	728	.61		1.02	
14	784	.69		1.12	At 14 unloaded returned to level.
15	840	.77		1.18	
16	868	.82	At 16 (the breaking point of Nos.	1.25	
17	896	.87	1, 2, and 3,) unloaded returned	1.46	At 17 considerable signs of crush-
18	952	.92	to a camber of .08 ins., and exhi-	1.61	ing appear.
			bited no signs of fracture.		
19	1008	1.00	At 19 unloaded returned to a slight	1.76	
20	1064	1.10	camber, though signs of crushing	2.07	At 20, splinters on the underside.
21	1120	1.21	begin to appear.	2.50	Weights briskly added, fracture
22	1176	1.40		3.00	takes place at 22, ultimate de-
23	1232	1.56	Signs of crushing increase.		flection 3 ins. Breaking weight
24	1288	1.75	Rested here for want of weight,		=10½ cwt.
			and unloaded returned to a per-		
			manent deflection of .16 ins.		

very closely resembled that shown in Plate III of Barlow's Essay on Timber, 3rd ed: London, 1826.

The elastic strength of Model	No. 1,	did not exceed	392 lbs.
do.	No. 2,	do.	560
do.	No. 3,	do.	560
do.	No. 4,	do.	1120
do.	No. 5,	do.	840

As indicated by the breaking weights, excepting only No. 4, which would have borne a few more pounds; and No. 5, which would have broken with less, *if time* had been allowed.

The ultimate strength of Model	No. 1,	was	868 lbs.
do.	No. 2,	"	868
do.	No. 3,	"	868
do.	No. 4,	"	1288+
do.	No. 5,	"	1176—

A comparison of the tabular results will show:

1. That, contrary to the experiments of Duhamel, wedging the stick upon the upper side to one-third of the depth, with slips of hard wood—at least in the extent to which we carried it—neither augmented nor impaired *the ultimate strength* of the timber, while it diminished its *stiffness.*

2. That the suspension truss, though it added to the *stiffness*, had no effect whatever, upon the *ultimate strength,* when only *two bearing plates,* (as *b* and *c*, Fig. 1,) were used, and the weight applied midway between them.

The reason of this appeared to be, that the deflection between the bearing plates, when added to the compression of the timber, at these, and at the abutments, allowed the beams to bend enough to exceed the deflection due to their elastic strength, before the suspension truss came fairly into action.

3. That the suspension truss, *with a centre plate* applied at *a*, Fig. 1, *doubled the elastic strength* of a plain girder of the stated dimensions, *and added near fifty per cent. to its ultimate strength.*

4. That trussing a girder with hard wood, in the usual manner, increased its *elastic strength* fifty per cent., and its *ultimate strength* about thirty-five per cent.

This last conclusion is nearly the same as that developed by Professor Barlow, in experimenting upon a similar truss. (See Treatise on the Strength of Materials: London, 1837, page 165.)

The experiments referred to, and of which we subjoin a synopsis, showed that though there was no efficacy at all, in a common girder truss, *of three pieces of hard wood, with queen bolts,*—indeed, that it was weaker than an untrussed stick,—still, the truss of *two pieces,*

with a king bolt, similar to that of Fig. 3, *did add considerably to the strength.*

Synopsis of Barlow's Experiments on the Strength of Girders of Wood.

No. of Experiment.	Distance betw'n the Props, in inches.	Depth of the Girder, in inches.	Breadth of the Girder, in inches.	Ultimate weight imposed, in pounds.	Ultimate deflection, in inches.	REMARKS.
1	68	2	$1\frac{7}{8}$	500	2.25	*Trussed*—not broken.
2	68	2	$1\frac{7}{8}$	500	1.55	*Untrussed*—not broken.
3	50	2	$1\frac{7}{8}$	953	+1.50	*Trussed*—broken.
4	50	2	$1\frac{7}{8}$	717	+1.00	*Untrussed*—broken.

Nos. 1 and 3 were trussed conformably to Plate 39 of Nicholson's Carpenters' New Guide, the former being a model of a girder of thirty-four, and the latter of twenty-five, feet span.

No. 1 was *a queen bolt truss, of three pieces;* No. 3 was *a king bolt truss of two pieces,* similar to Fig. 3, and the weights were applied in the centre, or over the angular point of the latter truss, and midway between the queen bolts of the former.

Hence it appears that whilst the queen bolt truss, No. 1, was actually weaker than the untrussed stick No. 2, the king bolt truss No. 3 was *thirty-three per cent. stronger* than the untrussed stick No. 4, of the same dimensions, and similarly strained.

Our experiments on model No. 5, which was trussed nearly in the same manner as Barlow's No. 3, display *an augmentation of strength of thirty-five per cent.* over that of an untrussed beam.

The close agreement of our results with those of Barlow, probably justifies the declaration that—at least whilst they are new—*the common wooden king bolt trusses, add one-third to the strength of the girders to which they are applied.*

Tredgold, however, in his invaluable treatise upon Carpentry, (2d Ed., London, 1828, p. 79,) says that "The methods in general adopted, (for trussing girders,) have the appearance of much ingenuity, but in reality they are of very little use." And again,—"The defects of ordinary trussed girders are very apparent in old ones, as it is not simply strength that is required, but the power of resisting the

unceasing concussions of a straining force, capable of producing a permanent derangement in a small surface at every impression."

As the tendency of time is undoubtedly to impair the efficiency of all sorts of trussing, and especially of those which—like girders trussed within their own depth—have *very obtuse supporting angles;* more extended experiments, and further observations, are necessary to settle definitively the question of strength, between beams trussed within themselves with timber, and plain sticks of the same bearing, and scantling.

In 1828, Mr. J. Conder, soon after applying in practice the suspension truss *of two angular points,* (see Fig. 1,) seems to have become satisfied that it was defective; for he soon brought forward, as a great improvement, the idea of forming the truss with but *one angular point,* like Fig. 3, inverted; and it will be remembered, that in our experiments we were unable to procure any benefit from the suspension truss, until by the central bearing plate at *a,* Fig. 1, we had, *in effect,* reduced that truss to one of *a single angular point.*

In trussing a girder, the main object is to strengthen the weakest point—which is the centre of the beam—and as Barlow's experiments upon direct *queen bolt trusses,* and our own, upon inverted, or suspension trusses, *of two angular points,* indicated that no advantage was derived from either, when strained in the middle, we are strongly disposed to conclude, that whether the truss acts by tension or by compression, it should (in most cases,) *have but one angular point.*

In support of this view, the writer may state that he has seen a number of suspension trusses of two angular points,—attached to the girders of bridges,—which, on close examination, indicated that they bore but little strain; whilst those with but one angular point, which he has had an opportunity of examining, seemed, in most cases, to be acting with much greater efficiency; this matter therefore seems to be of sufficient importance to justify our soliciting to it, the attention and consideration of professional men.

Philadelphia, April 28th, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Injudicious Policy pursued in the Construction and Machinery of many Railroads in the United States. By JOHN C. TRAUTWINE, *Civil Engineer.*

[CONTINUED FROM PAGE 316.]

The argument is not admissible, that perhaps in ten or fifteen years, the business of the road may increase to such an extent as to pay a profit on its cost. If the engineer wishes to ascertain if this be ac-

ceptable reasoning, let him suggest it to the stockholders before the road is commenced, and I suspect he will find but few to acquiesce with him.

But I see the sceptical reader elevate his eyes in astonishment. "What," says he, "the old flat bar! light engines! heavy grades! Is it possible the writer expects his readers to subscribe to so antiquated and exploded a creed as this? Even supposing his road to answer very well at first, with the limited business assigned to it, what will be done with it when the trade increases? *Ours* is a growing country, and the present business is no criterion to act on: in a few years it will have increased fifty, nay, a hundred per cent.; what is to be done then?"

The answer readily suggests itself: if the business increases 100 per cent., put on four engines instead of two. "But, ah!" says the objector, "there I have you. Don't you know that one heavy engine will draw a given amount of freight at less expense than a greater number of light ones can?" I most assuredly do know this to be true in the abstract; and I know, moreover, that a blind adherence to this "abstraction," has nearly ruined more railroad companies than one, in the United States. Let us illustrate this, also, by an example. Suppose our $ 10,000 a mile road to be finished, and in operation; its little models daily steaming it modestly over the line, with their thirty tons gross; and the stockholders annually pocketing their eight per cent. "net." This all does very well for a time; but "ours is a growing country," and soon the business on our road increases one hundred per cent. What is now to be done, is the question. One heavy engine can take all our increased freight at one load, at an annual expense for the maintenance, of but $ 5000; while on the other hand, if we employ two small engines to carry it, we incur an expense for maintenance of motive power, of some $ 9000 per annum. "Here is a pretty piece of business," say the Directors; "why did not our engineer foresee all this: here he has entailed on us an annual loss of $4000, at the very least. Did not experience, all the world over, show that railroads attracted new business to themselves? Did he not know that heavy engines were more economical than light ones? Did he not see that they were introducing them on all the English railroads? However, what is done cannot be helped; we have been behind the age long enough: let us try to catch up with it at last; let us order a thirteen ton engine, or rather, as the business will certainly continue to increase, let us get a twenty ton one, at once." This is accordingly done; and the "fell destroyer," this "monstrum horrendum *ingens*," is trotted out. They build a fire in him;—he snorts;—he starts;—he is off. "Ah! this is something like; now we are up

with the age." But, alas! in a few months things undergo a change. Rumors, faint at first, but gradually gaining strength, reach the Directors' ears, that something is going wrong on the road. An investigating committee is appointed; they visit the road, or rather the spot where once it stood; for the road itself has vanished: it is "*non est.*" After a long and laborious investigation, assisted by several scientific and practical gentlemen, the committee report that, first of all,—the bar was mashed into the timber;—and then—the timber was mashed into the ground. They moreover state their conviction that the flat bar has proved itself utterly unfit for railroad purposes; and suggest that as the Directors of the Liverpool and Manchester railroad have recently found it expedient to adopt an edge rail, weighing seventy-five pounds to the yard, *therefore* a similar rail should be substituted for the miserable flat bar on their road. The heavy rail is accordingly ordered, and laid down. "Now we are certainly up with the English; we have as heavy engines as they have, and as heavy rails; therefore, the road *must* pay well. We can carry sixty tons with our new engines, as easily as we could carry thirty with our old ones, and at very little more expense; that settles the matter. If the road yielded eight per cent. before, it must unquestionably yield 16 per cent. now, with double the business; and the expenses of transportation only the same as originally."

This certainly looks somewhat plausible; but it is found, notwithstanding, that somehow or other the road now don't pay at all. "What! our miserable flat bar road, and tea-kettle engine, pay eight per cent., and our edge rail, and twenty ton engines, a losing concern? How does this happen?" It happens thus: *the road has now cost too much*; eight per cent. on a road costing $ 10,000 per mile, is but four per cent. on one costing $ 20,000 per mile; and in our order to England, we omitted one very essential item to the success of heavy rails and powerful engines, and that is, a heavy trade. Now, had we, when our business increased 100 per cent., merely put on two more small engines, every thing would have worked very well; and the road would in this case have yielded sixteen per cent., instead of eight. It is true, that two heavy engines could, at an expense of maintenance of but $10,000 annually, have done the work of the four light ones, which cost annually, perhaps, $ 18,000; but in order to save this difference of $ 8,000, we must have had a road proportioned to the heavy engines; and to secure this would probably require an expenditure, the interest on which would be many times greater than the $ 8,000 saved on the engines.

The foregoing is, of course, but an imaginary case. Still it serves to illustrate the principle, or rather, *want of principle*, on which far

too many of our railroads are now being constructed, all over the Union. We see whole states falling into the error; indeed, we are falling into it, nationally.

I conceive that this mania for the *indiscriminate* use of heavy engines and rails, has done more injury to the railroad cause, than perhaps any other single consideration that has been brought to bear upon it; but "Dulce est desipere in *Loco*," appears to be the general motto, and it is probably useless to cry out against it. No position can be more tenable, more absolutely palpable, than that it is true economy to use the very heaviest engines, and best constructed road, *that the business requires.* But what constitutes a heavy business in one case, may be a very light one in another, and vice versa. The matter admits, in almost every instance, of calculations sufficiently approximate to determine the class of road, and machinery, that should be adopted; and had this expedient been resorted to on all our railroads, we should probably not have had a single one in the United States, yielding less than ten per cent. on its cost.

I sincerely trust that I shall not be accused of disaffection towards permanent railways, and heavy engines; on the contrary, I repeat emphatically, that they should be as permanent, and as heavy, as the business they are to accommodate can possibly justify. What would we think of a company who should purchase the Great Western steam packet, to ply hourly across the river at Philadelphia, with some five or ten passengers at a trip? Would we not pronounce them demented? And should they tell us that Philadelphia had gone on increasing so rapidly, and so regularly, for many years past, that they felt confident their number of passengers would increase 100 per cent. in ten or fifteen years more, would that diminish our suspicions of their insanity? But yet does it follow, because the Great Western would not be a profitable investment in this case, that therefore she is not a fine sea vessel, and admirably adapted to carry on a lucrative business between England and America? Or does it follow, that because *she* was a losing concern when running between Philadelphia and the opposite shore of the river, that therefore a first rate, substantial little steam ferry *boat* should not do an excellent business on the same route? Or, lastly, suppose that the engines of the two boats, should be respectively converted into locomotives, for accommodating precisely the same limited amount of business *on land*, does that in any degree alter the case? Is it not equally apparent in either instance, that the magnitude of the *trade*, and not of the *boiler*, must be depended on as the great prime mover of the enterprise? I certainly should consider the engineer who would advise the same character of road, and machinery, in every case, fully as deficient in

judgment as the company who should convert the Great Western into a ferry boat.

The remarks applicable to heavy engines, apply also to heavy cars. To diminish the weight of the engines, and still allow that weight to be exceeded by the cars, were evident impolicy. As before remarked, I should on our road, limit the weight on any one wheel, to one ton; and should, consequently, so proportion the cars, as that when loaded they should not exceed that limit.

We often hear the remark, nay, I presume that nine engineers in ten, throughout the profession, will yield it their unqualified assent, that the power of an engine is less on the flat bar, than on the edge rail, by some twenty or twenty-five per cent. In *strict justice*, I suspect there is no foundation for this assertion. I doubt not that an engine *adapted to the flat bar road*, will be found to exert quite as much power on it, as on the edge rail; but, unquestionably, if we place on it engines so heavy as to crush it, and deflect the timbers, a different result must follow. Indeed, it would not be difficult to conceive of an engine so heavy as to deflect the road to such an extent, as almost to deprive her of all locomotive power.

The examples assumed in the foregoing pages, have been taken at hazard, merely for the purpose of illustration; but so far as the character of road, and engines, which I have suggested, are concerned, I am of opinion that they will be found in very numerous instances, preferable to light grades, heavy edge rails, and powerful engines; particularly on the score of original expense. Roads built after this plan, will not partake so much of an experimental character, as those involving greater outlays; and, moreover, they would be adequate, under proper management, to accommodate, with perfect ease, far more trade than passes over half the roads in the Union. For example, there are few of our roads doing a business as great as could be taken at two trips daily, in each direction, by eight ton engines, over sixty feet grades. What folly is it then in such cases, to double the cost of the road for easy grades, heavy rails, and powerful engines? The arguments usually brought to bear against advocates for cheap roads is, that the business will soon increase to such an extent as to pay well on the cost of a first-rate road. This may be true in many instances, but there are more cases to which it is not applicable; for even admitting that the business did, in ten or twenty years, increase 200 or 300 per cent., it by no means follows, that even *that* amount would justify a first class road.

The engineer is not left altogether to the exercise of his discretion, or judgment, in the matter. It admits, as before stated, of an arithmetical determination, having the data of the probable amount of

trade that will be accommodated by the road. In collecting this data, he should shun alike, assumptions based upon the probable business of the road for the first day, or even week, or month, or year, of its going into operation; and thus having in view the prospective resources at the termination of the coming half century.

I will here take occasion to remark, that more, both of time and skill, will be required, to locate a railroad on the principles I have advocated, than on the ordinary plan. When, as is usually the case, the route is located, in great measure, with a view to long stretches of straight lines, easy curves, and light grades, the "modus operandi" is much less complicated, than when the engineer shall be obliged, at almost every step of his progress, to test his cuts, curves, &c., by the standard of justifiable expenditure. It is a very easy matter for the engineer to draw a long straight line on his map, and then tell his assistants to run it out; but it will be somewhat more difficult to decide on that line, between the same points, that shall best subserve the pecuniary interests of the company. In the one case, the route may be located *by miles;* in the other, it must be done *almost by inches.* Perhaps every engineer will bear me out in the assertion, that the difficulties of a proper location must be inversely as the finances of the company, should this system be adopted. As before remarked, the present plan has but little, if any, reference to that point.

I shall not attempt to follow Mr. Ellet into those cases which he supposes, in which it may become advisable to assume grades, more nearly coincident with the natural surface of the ground, and to dispense with the use of iron rails altogether; using cars no heavier than a light barouche. I may, however, be permitted, en passant, to express my entire assent to his views in that particular. Many short branches, from great thoroughfares to watering-places, or to small towns, might be constructed, and made to pay well, could we but divest ourselves of our "stereotyped" notions of what constitutes a good railroad. Witness the railways laid in coal mines: there are none more serviceable;—there are none that pay better;—yet they do not cost $20,000, or $30,000, a mile; nor do they ever feel the weight of even a *model* locomotive. How powerful an appeal do they make to us, *to proportion the means to the end.*

I will now add some further remarks in support of my views respecting the location of a line of railroad; and again let me express the hope that I shall not be misunderstood as expressing my ideas of the best *abstract* line, but of the best *paying* line;—not that on which a load can be propelled by the least expenditure of *power*, but by the least expenditure of *money;*—not that whose merits are apparent on the ground itself, but which are evidenced forth resplendently, in the

countenances of the stockholders, as they button up their pockets, on dividend day. I am fully aware of the obloquy to which an engineer exposes himself, in lifting up his feeble, and almost solitary voice, against any of the prominent evils of the day; and I am therefore the more desirous to be distinctly understood.

On nearly all our railroads, of any length, there occur at various points, maximum grades, of from thirty to fifty feet to a mile. These grades limit the capacity of the engines; and one such occurring on a road, (unless additional power be employed at that point,) does this quite as effectually as fifty would. Yet on the same road, we almost universally (perhaps *universally,*) see very great expense incurred all along the line, to secure much lighter grades, even where somewhat heavier ones would have coincided with the natural surface, and have involved little or no expense. This practice, *at least to the extent to which it is generally carried,* (for there are many exceptions,) I look upon as radically wrong.

Undulations in the acclivities of a railroad, it is admitted, must be allowed to a certain extent; but the precise limits of the expression, "certain extent," it is needless to say, have not been as yet defined. The application of the term must, of course, vary in each separate road; and perhaps its most literal interpretation, as sanctioned by practice, would be, "Such as the engineer considers the nature of the ground to require." This construction I should be willing to modify, by adding, "and the best interests of the company demand."

Admitting then, *that acclivities must occur* on the line, affecting the load of the engine, I am under the impression that the *number* of them may be increased greatly over what is customary;-or, in other words, that the graded surface may be made to conform much more closely to the natural one, than is generally done; and that it would be to the interest of companies, were that system adopted. Under such circumstances, a succession of undulations, within limits not too restrictive of the speed of the engine, it is well known would involve no loss of either time, or power, injurious in practice.

It is true, that Robert Stephenson, Esq., Civil Engineer, in his report to the Directors of the London and Birmingham railroad company, on the subject of undulatory railroads, objects that the variations in speed attendant on alternate ascents and descents, would create an irregularity in the intensity of fire in the engine, which is calculated to injure their boilers by frequent expansion and contraction;—and he states, moreover, that the parts of an engine should be calculated for a certain degree of speed; and that rate maintained as regularly as practicable while on duty, in order to secure the attainment of the most effective performance. He speaks, however,

with regard to the "*undulatory system*," so called, of Mr. Badnall; and from one of his observations, I suspect that his remarks are not intended to apply to such rates of acclivity as those I refer to; or to such as would permit the engine to start up them, with her load, from a state of rest. For he says, "*Inconvenience would, in my opinion, result from not having the power to halt at any given point on the line of railway. This may be done, without inconvenience, on a line of road not possessing inclinations beyond the power of the engine.*" Such inclinations, my suggestions, of course, do not embrace.

This is, then, the only objection (if indeed it be one) that I have ever seen, that appears to militate against the adoption of a constant succession of short undulations. Should there be others, that have escaped my notice, I have little doubt but that they would be countervailed many fold, by the saving of expense accruing from their adoption, on almost every road in the Union. Indeed, many of our roads might, in my opinion, have been materially improved, by applying the saving that would have been thus effected, to the reduction of their maximum grades. The profile of the road would, it is true, in this last case, present a greater number of undulations; but both the time, and expense, of overcoming them, would be less than in their present condition. The increased facility of drainage, in a railroad of this undulating character, should be taken into consideration, in deciding on its adoption, or rejection. The draining of long level reaches, is, in some cases, a matter of considerable difficulty. I doubt not, most of my professional readers can recal instances in which this inconvenience could have been obviated, and a far better road-bed made at much less expense, by the use of moderate undulations. in which the acclivities need not have been one quarter so steep as the maximum grade. None but a very inexperienced engineer would abuse this system, by so arranging his undulations as to create a continual variation in the speed of the engines, so considerable as to become a source of annoyance to either the passengers, or the engine-man.

But there is, unfortunately, a very powerful antagonistic principle, subject to no laws of either science, common sense, or economy, that is too frequently brought to bear upon the grades, curves, &c., of our railroads; and that is, a puerile pride: a determination to have a *handsome* road, at all events. We know that a succession of ascents, and descents, mars the beauty of a straight line most deplorably; and as the expense of the cosmetic is paid by the stockholders, and they are not aware of its precise amount, it does not matter so much to the engineer, if the road, in consequence of these superfluous embellish-

ments, should happen never to realize any dividend. In this case, nobody ever thinks of attaching censure to him: the road is very straight, and very level; and, in their opinion, it follows that the engineer has done all that was in his power, to make the project succeed. The amount of trade he, of course, cannot control; and the very fact of his having ruined one road, thus becomes his strongest plea for procuring the management of another. Had he made a road that would pay well, his professional character would probably have suffered an injury, from which it never would have recovered. Until the *public,* therefore, as well as engineers, begin to view this matter in its proper light, we cannot reasonably hope to see the proper remedy applied. A long straight line is considered quite a stepping-stone, by our aspirants after professional fame. It shows for itself; and speaks for itself; silently, but convincingly. A straight line, five or ten miles in length, creates more *talk,* and begets more *honor,* than a judicious curved route could possibly do; although the latter would have answered just as well, and have cost many thousands less. The public must learn, that in a railroad, as in women, beauty is not a safe criterion of merit.

Another frequent source of unnecessary expense in the location of railroads, is the attendance of a "Committee of Survey," appointed from among the Directors, *to assist the engineer in making his location!* The primary object of this committee, we are in charity bound to suppose, is to prevent, by their intuitive skill, too much use of the level and compass; at least, this is certainly all they ever *do* effect. These gentlemen are generally as innocent of all knowledge of the principles of a location, as "the child unborn;" and, by their twaddle, they soon torment the very life out of the engineer. Their questions, and remarks, must be listened to; and to do this is utterly incompatible with any attention to the location. This demands, at every step, the undivided observations of even the most skilful engineer; and admits of no diversion from the main object. Therefore, after a few miles are located, the engineer, completely exhausted by his double duty, invokes all sorts of maledictions upon the committee, and determines upon the long-straight-line system, as the only relief from his misery. He starts his corps off at a tangent, through thick and thin, for some object several miles distant; and *then he is at leisure to talk.* He is commended for his long straight lines; the committee for their vigilance; and the stockholders pay the costs.

Let Directors, if they *must* appoint "Committees of Survey," give them instructions to *remain at home, and let the engineer alone;* and further, if he reports that he has finished his examinations, and surveys, in an unprecedentedly short time, discharge him, and procure

another to make a thorough and correct survey. They will generally save at least one-third of the costs of their grading by this process. *It must be a long purse, that pays for a short survey.* Although I have treated this last subject in a somewhat sportive manner, it is nevertheless one worthy of the most serious consideration. Let Directors employ an engineer, in whom they can place *unlimited* confidence for professional skill and integrity; then give him his general instructions, if they have any to give; and afterwards leave him entirely to himself in his operations. And especially let them, in their mercy, refrain from urging upon him their sons, nephews, and other "very talented young gentlemen," as assistants. Let him choose his own assistants; and let the Board abstain, most religiously, from any interference with them. They are the engineer's tools, by which he carries his plans into execution. No one else should meddle with them; to do so, will inevitably blunt their edge, and give to both the workman, and his employers, trouble and expense. Harmony among the officers, is all essential to the proper prosecution of any project; and the remark applies with peculiar force to works of internal improvement. The engineer, if he be the kind of man above supposed, will feel himself identified with the work under his charge. His interest, his pride, his professional character, are all concerned in its success. No stockholder, no director, can possibly feel that intensity of interest in it, that he does. Every effort he can make, will be brought to bear upon its successful accomplishment; but let once the Directors begin to meddle with his operations: let them pass along the line, and give directions to his assistants, or contractors: let them evince any want of confidence in his integrity, and the charm is dissolved. His interest is changed to disgust. His professional pride no longer sustains him, and inattention must *inevitably* follow; and just so certainly as that happens, the work must suffer.

If Directors could consent to leave the principal management of the matter to the engineer, there can be no doubt, that in almost every instance, he could either prevent claims for land damages entirely, or else reduce them to a very unimportant item. But to effect this, it is *essential* that he should act either alone, or through a discreet agent, who must be entirely in his confidence, and *under his control.* A sum sufficient to defray the engineering expenses of the entire work, could thus be saved, in nearly every case; but it can be done only through the engineer; and not even through him, unless he be permitted to keep his own secrets, until the whole matter is arranged.

It is not my intention to treat on the management, or conducting, of a railroad, after its completion. I will merely observe, that it is a great error to entrust it, as is almost universally done, to men of very

limited information. The general agent of transportation, under whose direction the operations of the road are conducted, should be an engineer, of considerable attainments; although it is not necessary that he should be one of the first grade. The professional ignorance of most of the conducting agents of our roads, is a lamentable source of waste. Many of our unproductive works could be made profitable, by a change in that department alone.

In conclusion, let me again earnestly request that no mis-construction be put upon the foregoing pages. There are many railroads in the United States, to which my remarks are not at all applicable; but there are also many to which they are. Where there is a very heavy trade to be accommodated, I am in favour of easy grades, curves of large radii, heavy rails, and powerful engines. But in all cases, these traits should be combined only so far as *the interests of the companies will justify*. I maintain that our engineers should construct their roads, with a view to *paying* well, instead of *looking* well; and that in looking to England for precedents, they should rather apply the *principles* there developed, to our own case, than attempt to indulge in an imitation of their splendid *practice*, when so doing must necessarily bring ruin upon those who embark their all in the enterprise. Nothing can be more evident, than that we have, in numerous instances, transcended the limits between *abstract* and *practical* perfection in our railroads. The former, as before remarked, is that in which the greatest load can be propelled by the least *power*; the latter, in which it can be done at the least *expense*. The expression, "a good railroad," is a *comparative* one; we have erred all along, in supposing it to be *positive*. It is to correct this evil, at least partially, that I have been induced, on the perusal of Mr. Ellet's pamphlet, to add my exertions to his, by the publication of these pages. Being written on the spur of the moment, and in the order they presented themselves, on reading his pamphlet, my remarks are, of course, crude and incomplete. The subject admits of much enlargement, and I hope to see it followed up in future numbers of the Journal, by more vigorous pens than mine. In the meantime, I cannot do better than to recommend to those who wish to see it more ably handled than they have found it in this paper, to study carefully Mr. Ellet's judicious remarks, in the pamphlet alluded to.

Tennessee, February, 1842.

Projected Water Works at Albany, New York.

We have been favored by W. McClelland Cushman, Esq., Civil Engineer, with a copy of a recent report made by him to the authori-

ties of Albany, on the means of watering that place from the Mohawk or Hudson River.

It appears to be settled, by long experience, (with few exceptions,) that very populous towns, cannot easily be supplied with salubrious water from springs, or wells upon their sites; because the contaminating causes incident to a dense population, sooner or later, impregnate the existing waters of the place with impurities, both offensive and deleterious.

Consequently a necessity arises, at some period of the growth of almost every town, which demands the procuration of water, for beverage and culinary uses, from distant and uncontaminated fountains.

This necessity has created an independent branch of engineering, scarcely yet reduced to the character of a precise art, the importance and utility of a clear knowledge of which—especially in a country fast increasing in population—must be manifest to all.

It has often been to us a source of regret that no authoritative work, or text book, exists, which contains at once both the principles and the details, indispensably requisite for the correct guidance of works of this character; such a production is at present a desideratum in civil engineering, and one which we do not despair of seeing supplied, by some of the able men now engaged in the important business of watering our cities.

To return to the immediate subject in hand, we conceive that Mr. Cushman by adhering too closely to the theory of this question, (of which he is undoubtedly master,) has fallen into some practical errors, which the importance of the subject as a matter of engineering, induces us to point out.

In this task we have been materially aided by consultation with practical men, entirely conversant with the experience developed in the use of those celebrated works by which this city and its suburbs are so successfully watered, *through cast iron conduits extending more than* 110 *lineal miles, and daily delivering to the people nearly four and a half millions of gallons of water.*

The following points in Mr. Cushman's report appearing to us to be discordant with practical results and views, we shall offer a few remarks upon each.

I. After establishing the height of the fountain, necessary to cause the water in the conduit to flow to the roofs of the highest houses in Albany, he proposes "for the extinguishment of fires, *an additional head of ten feet,* as great enough to force upon the roofs (from the streets we suppose,) a jet d' eau, by means of a short hose applied to the hydrant, and *without* the intervention of ladders, &c."

Upon this we may remark, that although the reservoirs at Fairmount possess an average command over the pavements of the greater part of Philadelphia, quite equal to that proposed at Albany, (55 feet,) still it is not found possible in practice here, to throw water upon the roofs of burning buildings, by the mere force of hydrostatic pressure; but almost invariably, it is from necessity first poured into engines, by the hose, and thence projected by manual labor.

In view of these facts, we can come to no other conclusion than that *the additional head of ten feet* above the levels of the roofs, will be found wholly insufficient to project from the streets a jet d'eau upon those roofs.

To strengthen this view we will observe that there is now in action at Fairmount, a jet d'eau, established under very favorable circumstances, for producing a high projection of water—the pipes of supply are of the most ample dimensions—the adjutage comparatively of small size, and duly proportioned according to art—yet it rises in the air but little over thirty feet, though actuated by the full head of the reservoir, nearly eighty feet perpendicular above the adjutage; theoretically this jet *ought to rise* much nearer to the level of its head, but the stubborn fact is that *it will not.**

II. Mr. Cushman proposes to cause his conduits to follow the average contour of the ground, graded for the purpose in planes as long as possible.

To this there can be no objection, provided sufficient strength is given to the pipes, a suitable increment of head added for every undulation of the conduit, and a proper air valve placed upon the summit of every vertical convolution.

III. Mr. Cushman proposes the construction of *"depurating sections"* and *"roil chambers,"* in the lowest undulations of the conduit, with sluices to clear these undulations from sediment.

Now as *settling reservoirs* are also proposed in this report, it seems to us that though a simple cock placed at the lowest depressions, might occasionally be serviceable, the *sediment apparatus,* as planned and described, is both unnecessary and objectionable—*unnecessary,* because experience in this place, where undulations of the con-

* It may be useful to be more explicit in describing this jet d'eau; the pipe of supply consists first of an old sixteen inch main—devoted to this purpose only—which descends from the reservoir, on the summit of Fairmount, to a plane about eighty feet below it; here a branch pipe, of four inches calibre, is taken off horizontally about one hundred feet to the fountain, where it joins *a short vertical pipe* of one inch in diameter, which at the adjutage is contracted gradually to five-eighths of an inch, by means of cones, according to the principles of Venturi; and, though an orifice in a thin plate set in the four inch pipe, would have been more effective, still this is a case favorable to the production of a high jet—yet such a jet as might have been expected *does not result.*

duits are frequent, indicates that if the pipes are laid in sections of *uniform aperture*, duly proportioned to the service they perform, and possessing a suitably commanding head, it is only requisite to open the fire plugs occasionally to produce an effectual scour through the pipes, and bring forth any sediment which may have lodged within them;—*objectionable*, because the *roil chambers* being *enlargements* of the conduit, *preceding a contraction*, will obstruct the flow of the water, and have a direct tendency to produce the very evil they are designed to cure, whilst at the same time they would occasion an additional expense, which might be much more advantageously applied to augmenting the altitude of the working head of water.

IV. Mr. Cushman calculates that a thickness of one-twentieth of an inch of cast iron would be *"amply sufficient"* for an eighteen inch conduit pipe, working under fifty-five feet head! But for perfect safety he finally establishes the thickness at fivefold, or *one-quarter of an inch*, and thence estimates the weight of metal per mile of conduit, at 103½ tons.

Now the cast iron conduits of this city, of eighteen inches calibre, working many of them under a head not exceeding that mentioned above, have had their proportions established by over twenty years' practice, and are now made *two-thirds of an inch* thick in the body, and weigh 410 lbs. to the yard lineal, or 322 tons per mile of pipe, *being more than treble that prescribed by Mr. Cushman!*

We may, possibly, be told that two-thirds of an inch is a much greater thickness than would be dictated by formulæ based upon the known value of the cohesive force of cast iron—and this we readily admit; but at the same time, *here is the practical fact*, that the conduits in the general plane of Philadelphia—working under nearly the same head as that proposed at Albany—require to be made two-thirds of an inch thick, and tested, too, by Bramah's press, under an hydrostatic pressure equivalent to 300 feet head, before being laid down; yet notwithstanding all this, they do sometimes fail, *though very rarely*, and though it may be said with truth that these failures usually occur at imperfections, still it shows the large margin necessary in practice, to guard against those very imperfections, which are unavoidable in castings, and which the hydraulic press does not always point out.

If, then, the conduit pipes for the water service of Albany, be proportioned by the practical scale established by more than twenty years' actual experience here—the propriety of which but few will question—the cost of this item alone will thrice excel that expressed in Mr. Cushman's estimates, (p. 21 of the report,) or be more than $300,000, instead of less than $100,000!

V. Mr. Cushman proposes that the pipes should be cast in lengths of fifteen feet.

And on this we shall only remark that those of nine feet long have hitherto been found sufficiently difficult *to cast well,* and the opinion of practical men in this quarter is decided, that *good pipes* cannot be cast in lengths of fifteen feet, without increasing the weight per lineal yard, to guard against unavoidable imperfections.

VI. Mr. Cushman proposes *to use zinc instead of lead* to seal the joints of the conduit pipes, under the impression that by galvanic action it will prevent the iron from corroding.

Of this plan it may be observed, that wherever one metal in a galvanic circuit is protected by *another,* it must be at the expense of *that other;* if, then, the zinc joint protected the iron pipe, it would be *itself* corroded, and from this cause the joints would soon become imperfect, and need repair.

Moreover (to take no account of its extra cost,) zinc is too friable to admit of being set up with the cold chisel, after being cast into the joint—which is an indispensable precaution—and it may well be doubted, whether its very slight ductility would successfully admit, the expansion and contraction which takes place in metallic conduits, and to which the common joint of lead so admirably adapts itself, as to leave absolutely nothing to be desired, in point of tightness and durability; indeed, some which have recently been examined *after thirty-three years' use, were found to be in perfect order.*

VII. Mr. Cushman proposes so to gear his forcing pump that the water in the rising main, when the pump is working, shall have a velocity of *only sixty-five feet per minute,* or "thirty single strokes" of a twenty-six inch barrel.

Now experiments at Fairmount have conclusively shown, that when the working velocity of the water in the main, ascending from the forcing pump to the reservoir, *is less than* 120 *feet per minute,* the momentum is not kept up, whilst the piston clears its dead points; and consequently a reaction then takes place upon the principle of Mongolfier's ram, which would quickly destroy the most solid apparatus; it is on this account, as well as with the view of avoiding gearing, that the water wheels at Fairmount are run so much faster than theory dictates—or than otherwise would be desirable—and not from any want of knowledge of the best abstract velocity at the skirt, as some uninstructed critics have imagined.

The length of the force pump stroke, as proposed by Mr. Cushman, is twenty-six inches, which, we are inclined to believe, *is too short for advantageous action.*

There are some other points in the report under review which seem

open to objection, but as they are comparatively of minor importance, we will conclude our remarks without entering upon their discussion; indeed nothing but the importance of this practical question could have induced us to review Mr. Cushman's report at all, as we entertain the highest respect for his talents, and feel convinced that with a closer attention to practical results, he would unavoidably have been led to conclusions identical with those above enunciated.

Facts and Observations on Four and Six Wheel Engines. By JOHN HERAPATH, ESQ.

[CONTINUED FROM PAGE 320.]

Birmingham and Gloucester Railway.

Having heard a good deal of the American, or Bogie, engines, I was desirous of riding on them, and Captain C. R. Moorsom, the Chairman, and Mr. Sturge, one of the Directors of the line, having politely granted me permission, I went on the 16th ult. from Birmingham to Cheltenham, 46 miles, on one of Norris' engines, and returned on a copy of the principle built in England.

The readers of the *Railway Magazine* are aware that one of the distinguishing features of these engines is the cylinders being outside, near the head of the engine, with a very long connecting link, or rod, turning by a pin the hind wheels, four feet diameter. Another is the bogie front, that is, four two feet six inch wheels, the two axles of which are very close together, attached to a frame, which has considerable motion round a vertical pin. By this means the engines traverse a curve of only ten chains radius near the Birmingham station with great facility, and without, as far as I could perceive, any undue strain.

I went from Birmingham to Cheltenham on one engine, an American, of Norris' make, and came back on an English model of it.

The first, No. 7, the *Atlantic,* I was informed by Mr. Bishop, the intelligent superintendent of locomotives, who went with me as far as Broomsgrove, weighs in its working trim near ten tons, with about six on the driving wheels. Its cylinders were ten and a half inches, with an eighteen inch stroke. At first I was very much pleased with this engine, and fancied it was the steadiest I had yet traveled on. Its lowness and easy motion at moderate speeds won very much upon me, and impressed me with great confidence. When, however, we came to a speed of above twenty miles an hour, or up to twenty-five or thirty miles, the motion on the platform was a most disagreeable wriggling side motion, which kept time, as far as I could judge, with the beats of the pistons. It was the same on both engines at the same speed. I tried in vain to discover the cause of it. No such motion, or anything approaching to it, had I observed in any engines on which I had been. Mr. Bishop and myself thought, while traveling on the engine, it might be owing partly to the road, and partly to the play of the axles in the bearings; but as it corresponded in both engines, I

was subsequently inclined to think it owed nothing to the road, and was due entirely to the vibrations occasioned by the sudden checks of the matter in the piston, and its material, and the working of the engine against itself, that is, its working too quick for the steam behind the piston to have time to escape. It is probable, therefore, that was the expansive action of the engines—for I am informed they work in part expansively—adapted to the highest velocity required, and the steam behind the piston allowed to escape earlier, none of this unpleasant motion would exist. But these engines are put to motions they were obviously never intended for. Thirty and more miles an hour, which they often travel, they plainly tell us by their laborious motions they are unequal to.

As a part proof of this, I am informed that four engines which the Company have had made, with outside cylinders and five feet driving wheels, by Forrester, to take the mail trains, have no such motions as are found in the American engine and its English imitation.

From what I have seen, I am no great admirer of American engines for general purposes, though the men relate marvellous things of them upon that line.

Besides the wriggling motion mentioned, I could very plainly distinguish the same sinuous motion I had observed on the South Western and London and Birmingham lines.

Captain W. S. Moorsom, the engineer of the line, seems to have a very good opinion of the principles of these engines. I am sorry to differ from a gentleman for whose talents I have a very great respect, but if I am to form my judgment from the two whose performances I have witnessed, they will not have an advocate in me. I could compare their uneasy wriggling motions at high velocities, to nothing but that shuffling amble which is observable in some small ponies, and I cannot help thinking but that they must have considerable wear and tear, and be expensive to keep up: and this, I since find, is fully borne out by the facts. Some of the men, however, are enthusiastic in their favor, and ridicule the idea of "Bury's engines" being able to compete with them on their line. They say the trial has been made, and the superiority of the American engines placed beyond a doubt. The rationale of this I am unable to see, but if it be so, it settles the question, and proves that little engines, like little horses, are best suited for hilly countries; but why then, as it will presently be seen, are the Company improving them, by substituting five feet, for four feet driving wheels?

The length of line worked by this Company is fifty-five miles, including the Tewkesbury branch of two miles; and when the Worcester branch is opened, four miles, and the line extended one mile further, to join the Gloucester basin, which I understand is now in progress, the total distance worked will be sixty miles; the cost of construction of which will be between £24,000 and £25,000 a mile.

The locomotive stock of this Company consists of twenty-nine engines, including three ballast engines and three "bank engines," to help up the Lickey incline, which last three never work trains. All the traffic engines are six wheel, with bogie frames, to the centre of

which the smoke-box is attached by a centre pin, the engine framing on both sides of the smoke-box resting on stands acting on the bogie frame springs. The cylinders are all outside, and the framings, except of four, all inside. There being no crank axles, the driving-wheels are set back close to the fire-box. The weight of the engines varies from ten to thirteen tons, in their working trim, of which from six to eight lie on the driving-wheels. Most of their engines have driving-wheels only four feet diameter, and the four other wheels being two and a half feet, but they have an engine with five feet driving-wheels, and four others with five and a half feet, the leading wheels of which are from two and three-fourths to three and a half feet diameter. Improvements are now making in these engines, by putting on five feet driving wheels, "and giving as much head as possible to the reduction," or exhaustion, of the steam.

Eighteen of the traffic engines, including the three bank engines, are now in an efficient state. The detentions have been rather numerous, in consequence of the pumps, and other parts of the engines, with the small driving-wheels, having occasionally failed; but it does not appear that they ever had a driving axle fail, except a crank axle in an old ballast engine, eleven years old, which happened at some temporary points; nor have they ever had any engine run off the line. The average cost of the engines is £1,430.

Their gross loads are about fifty-one tons; their consumption of coke, thirty pounds to the mile in Forrester and Nasmyth's engines, and forty pounds in the others.

With regard to their own engines, they find the five and a half feet driving wheels work the best. The chief motions are the sinuous and horizontal vibrations, or tremors, which are most conspicuous in the *Bogie* engines on descending gradients, but on curves there is little or no difference. These motions are considered to be in part, but not wholly, due to the road. They have no top-heavy engines, nor any direct proof that the distance of the cylinders from the principal axis of the engine, has any effect on the sinuous motion; but Mr. Bishop is of opinion that the outside cylinders have.

The average expense of repairs of their engines, for the half-year ending the 30th of June, was £103 per engine, including several new copper fire boxes and tubes, the total distance run in the same time being 110,000 miles. The steam pressure is 60 lbs. per square inch.

Their best engines are Forrester's, three years old, and the worst the *American*, two years old. In their fastest and least expensive engines, the moment the steam is cut off from the induction pipe, the eduction is opened.

Mr. Bishop has addressed a letter to me since I have been out, in reference to the premiums for economizing the coke, in which he says: "for the last three months' consumption, I find forty-four pounds of coke per mile as the general standard, and for every pound which the fortnightly returns show it to be under, the men have £2 to divide among them. Thus, the first fortnight the average was thirty-eight pounds, and therefore the men had £12; the second fortnight the average was thirty-nine pounds, and the men had £10. Each driver's

share for the month was 14s. 8d., the firemen, cokemen, &c., receiving less, in proportion to their wages."

London and Birmingham Railway.

The locomotive stock of this great Company consists of ninety engines, that is forty-two with twelve inch cylinders and eighteen with thirteen, all uncoupled engines; and thirty coupled engines, with thirteen inch cylinders for goods. All these engines are four wheel, and have inside bearings. The weight of the 12-inch cylinder engines, in their working trim, is 9¾ tons, having 5 tons 18 cwt. on the driving wheels, and 3 tons 17 cwt. on the front wheels; the 13 inch uncoupled weigh 11½ tons, with 6 tons 11 cwt. on the driving-wheels, and 4 tons 19 cwt. on the front; and the 13-inch coupled weigh 11 tons 13 cwt., of which the same weight, 6 tons 11 cwt., lies on the driving-wheels, and 5 tons 2 cwt. on the leading wheels. The coupled engines are said to work most satisfactorily, but I presume this is meant for goods, as whenever they are worked with the passenger trains, that is at high speeds, I observed the coupling rods are taken off.

Of these 90 engines, 81 are now in an efficient state, and ready to take a train.

During the last two years there have been ten cases of fractured crank axles. In no instance, however, did the engine fail to take its load to the next station. Seven of these cases have been with goods on coupled engines, and only three with passenger or uncoupled engines. The cause is alleged to have been that singular fact mentioned in my account of the Grand Junction engines, namely, the deterioration of the quality of the iron of the axles from use, which converts hot short into cold short iron.

From these fractures no personal injury was done to any one.

It appears that there has been but one solitary instance (Nov. 4th, 1837) of any engine having run off the rails, which happened between Harrow and the Brent, and was caused by the unsound state of a part of the road then newly opened. It happened with one of the 12-inch cylinder uncoupled engines.

The average pressure of steam is about 50 lbs.; consumption of coke, 40 lbs. per mile; and the gross loads taken are given to me as 61 tons, but I suspect this is the average passenger loads, for we often see trains of goods of an almost interminable length.

It is a fact worthy of notice that their heavier trains are the up, that is, those towards our bottomless gulph—the metropolis—a circumstance which was not contemplated or foreseen before the line was opened.

The cost of their engines is from £1,300 to £1,350, exclusive of tender; the annual expense of repairs, per mile run, about 3½d., and the number of miles run, from June 15, 1840, to June 15, 1841, was 1,066,014. They have no top-heavy engines, and the motions chiefly observed are the sinuous. If an engine has any other motion, it is always found where the road is imperfect.

Their oldest engine, No. 1, I understand has been at work from July, 1837, and is still perfectly effective and steady.

Some very cogent reasons are given me for the preference by this Company of four wheel engines to six; but as they are somewhat long, I have thought it better to reserve them for my report.

More detailed accounts are, that for 6 months ending the 15th of June last, there were employed 16 foremen, clerks, and store keepers; 51 engine drivers, 8 stationary enginemen, 50 firemen, 168 cleaners, cokemen, and laborers on running engines; 93 fitters, erectors, and millwrights; 16 turners, 6 men working on machines, 11 carpenters and pattern makers, 5 coppersmiths, 9 brassfounders, 23 blacksmiths, 3 spring-makers, 36 stokers, 22 boiler-makers, 4 painters, 6 general laborers, and 12 boys; making a total of 539 men and boys. And this number, it will be observed, is employed solely in the locomotive department and in repairs, without any being employed in the manufacture of new engines. Their places of occupation are at four stations.

The 6 months wages for enginemen, firemen, cleaners, cokemen, and laborers on traffic, amount to £7,444 18s.; the coke consumed was 10,012 tons, costing £16,139 6s. 8d.; the oil, 4987 gallons, at an expense of £827 2s. 6d.; the cost of water and firewood, £859 6s. 10d.; the wages or repairs, repairs not done by the Company, and stores or repairs, were £9,448 8s. 5d.; and general charges for tools, stationary power, clerks, foremen, store keepers, and other incidental expenses, were £6,389 10s. 7d., making a grand total of £41,108 13s.

The miles run, including assistant and pilot engines, with passenger trains, were 416,995, and with goods, 126,923. The average weight of passenger trains, exclusive of engine and tender, is 40 tons, and of goods with the same exclusion, 86 tons; and coke consumed per mile for all the trains, including getting up the steam, waste in stoppages, rests, &c., 41 lbs.; the average cost of repairs per mile run, was 4.17d., and of coke, 7d.; and the total cost per mile, including everything, 17.68d.

Six hundred bridges, or between 5 and 6 to a mile, I have been informed, are upon this line, many of them of course perfectly useless, and wantonly extorted from the Company in the progress of the Bill through Parliament. By the vultures in the House, and the cormorants out, near half a million of money was plundered from this Company, for land only, over and above its reasonable value. Had the Parliament exercised a little common sense, instead of the uncommon folly which dictated the 10 per cent. clause, it might, in suppressing the robberies for land and compensation only, have saved this Company more than sufficient to enable it to carry the mail-bags for nothing.

This great line, as the readers of the *Railway Magazine* know, unites the metropolis of the British empire with Birmingham, and forms the main railway artery to the north and north-west of England. Though it passes over a difficult country, its gradients are pretty good, that is, none I believe exceeding 16 feet a mile, except 1½ mile at the London end, worked by a stationary engine.

Much of the material on the line is good, but there are other parts

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containing that untiring nuisance to railway engineers, called clay. Here is a constant source of expense; which, however, the large and ample revenue of the Company feels but slightly in comparison to what other Companies would. By constant vigilance these parts are kept in good repair; and, from what I have observed on other railways, though it has not escaped the influence of the late rains, it has felt them less than most, and far less than some.

It has often been asserted to me, that this line is incapable of managing the immense traffic which flows in upon it, and that another line will be necessary to the north. While I have been out I have endeavored to pay some attention to this, for the purpose of obtaining correct ideas thereon. I have, as far as my opportunities would allow me, watched their operations, examined their force, and considered their system, and I am of opinion that their force is so ample, and management so systematic and apparently so easy, that I am of opinion double the present traffic would not much inconvenience them, even as they now are, while I think there can be no doubt that the line might easily take three or four times the quantity it now does.

Monday, Nov. 22nd.—I again traveled upon two of the Company's engines, namely, No. 44, a two year old mail engine, and No. 9, both built by Bury. The first engine I found not near so steady as the second, which was also much more lively, and tripped off with her load in gallant style. I was informed the first consumed 12 cwt. of coke in 52½ miles, and the second 14 or 15 cwt. in 60.

On Thursday, December 9, I came once more upon the line, in my return from the north, and I rode on No. 5 and No. 79. The latter was a coupled engine, with the coupling rods off. Having now been accustomed for two or three weeks to six wheel engines, and somehow had the sympathy of my prejudices excited in their favour, from the constant vibration in my ears of other parties' opinions in their favor, I entered the line with probably more unfavorable than impartial notions of four wheel engines. I imagined my former experience of them to be erroneous, and that I was now about to see the opinion of those I had mixed with, of their roughness, pitching, rolling, and dancing about, confirmed. I was, however, most agreeably surprised to find, not only my previous sentiments of them strengthened, but that they certainly were, to my mind, superior to the majority of six wheel engines in which I had ridden. As it was probably the last time I should be on this line in this survey, I tried these two in every way I could, and I found them comparatively free from the distinguishing motions of other engines, and most decidedly vastly more free from them than nine out of ten six wheel engines I had tried. No. 5 was a very steady engine, but No. 79 appeared to me to be steadier, and sweeter in her motions.

In examining these engines, I found them very firmly put together. The wheels of No. 79, contrary to other engines I had been on, appeared to have no sensible play whatever in the axles; they were so perfectly vertical to the axle-trees, that they ran with the greatest truth. I cannot say that either of these engines was wholly free from

longitudinal, or lateral, motion; but at velocities of about 30 miles an hour, it existed in them in a very small degree.

In now taking my leave of the London and Birmingham Company, I only discharge my duty to my conscience in acknowledging that their whole conduct to me, throughout this affair, has been one unvaried course of kindness and attention. Everything I have asked has been promptly granted me; every assistance I have needed has been given in a way to double the pleasure of receiving it. So far from holding back, they have seemed to take a pleasure in anticipating my wants or my wishes; and that generous conduct which began with Mr. Glyn and Mr Creed, has been handsomely followed out by his assistant, Mr. Long, and Mr. Robinson, Mr. Jones, and every other officer and servant of the Company, with whom I have come in contact, or had intercourse. Railway Mag. Dec. 1842.

[TO BE CONTINUED.]

Advice to Stockholders in Railroad Companies, from Herapath's Railway Magazine, but suited as well to the Western, as to the Eastern Hemisphere.

The period has now arrived, when in most cases the lines are completed, and questions of construction have to give way to those of administration. The lines are made, the great point now is to make the most of them by extending the traffic, and by regulating the expenditure. Let every Shareholder keep a watchful eye as to what is going on, for his conduct at the present meeting will much determine his dividend at the next. Let him see that the traffic is carried to its full extent by moderate and profitable fares, and what means exist of bringing other lines into communication, or assisting in the formation of new ones. He must have satisfactory explanations that the expenditure is not upon sinecure or extravagant offices, at the same time that he must take care that the officers and servants of the company are properly paid. A few well-paid officers are worth a legion of under-paid and discontented pensioners, and false economy with this class may, as in recent cases, be not without its effect upon the income. We cannot refer to the recent defalcations, and to the discontent prevailing among railway employees, without alluding to the fact of the dividend of the Manchester and Birmingham Railway Company having this half year suffered a diminution in consequence of misconduct on the part of one of the establishment. A lesson this, which will not, we trust, be lost upon those who are inclined to penny wisdom and pound foolishness. A cheap, that is, an unqualified servant, will always waste more than is saved on his salary, doing less work, and requiring more superintendence.

To secure good management, it is not enough to ask for it or to talk about it, but to choose the men best qualified. Where you have no auditors, ask for them, and insist upon having them, and chosen by yourselves—where you have to fill up vacancies in the direction, take care to put in proper men. Many a line at the present moment

requires a sharp eye; there are other things than the petty fees to attract the corrupt or the greedy; in the expenditure of thousands and hundreds of thousands, there is much more to be got by a practised hand, than from all the fees that a most diligent attendant can finger. The fees, we are convinced, attract but very few, and those, perhaps, the best men, the real working men; vanity and the love of pre-eminence and power may incite some; but the main incitement towards the direction, in low minds, is the love of a job. These are men to be closely looked to, men who will use every exertion to intrigue themselves into office, and then remunerate themselves at the expense of their constituents. One of these men is in league with a coal-merchant, another with a coachmaker, a third supplies timber sleepers, and a fourth, rails. Even to the clothing of the policemen, the oil and grease for the engines, and the stationary for the office, nothing is beneath the notice of these worthies; every one has a share of the spoil, and so generally are some boards affected with these practices, that the contracts of the line are as sytematically quartered out as the patronage of a cabinet, and each receives a share according to his merits. Mr. Alderman Jobbins has a son who is a tailor, and he takes the clothing; Mr. Deputy Grub lays his hands on the supply of coals and coke; the Chairman walks off with an order for rails; and his deputy undertakes to get the carriages repaired. These are very useful things to keep up influence in a man's parish, or ward, while the several parties who reap the fruits of the system are bound to use their power in keeping the Directors in place. Neither are such Directors always contented with their fees, or their patronage, but frequently they must have vestry dinners at the Company's expense, and turn the board room into a free and easy, where pots of porter and mutton chops are brought to aid the deliberative powers of the midday councillors, and restore their energies, exhausted not in the Company's service. All these things are to be looked at, and the parties engaged in them, when found out, to be removed from office; but Shareholders will do but half their work if they are not at the same time cautious by whom they are replaced. There can be little difficulty now in finding a sufficient number of tried public men, who are willing to accept office, and there is quite enough legitimate patronage and power to render any plea for jobbing quite inexcusable.

Physical Science.

History of the Reflecting Telescope. By the Rev. T. R. Robinson, D. D., M. R. I. A.

After explaining the relative importance of magnifying and illuminating power, Dr. Robinson proceeded to give a brief sketch of the history of the reflecting telescope, which seemed to have been forgotten for many years after its invention, till it was revived by Hadley. The labours of Short soon gave it celebrity; yet even this artist limit-

ed himself in almost every instance to sizes which were not more powerful than the achromatics of his day, and his large instruments appear to have been failures.* It was not till a full century after the publication of Newton's paper, that Sir William Herschel gave this telescope the gigantic development which has crowned him with imperishable fame; and by the construction of telescopes of nineteen and forty-eight inches aperture, placed regions almost beyond the scope of measurement, within the reach of human intellect. But as Short, in a spirit unworthy of his talents, took care that his knowledge should die with himself, and Herschel published nothing of the means to which his success was owing, the construction of a large reflector is still as much as ever a perilous adventure, in which each individual must grope his way. Accordingly, the London opticians themselves do not like to attempt a mirror even of nine inches diameter, and demand a price for it which shows the uncertainty and difficulty of its execution. In Ireland we are more fortunate, for a member of our Academy, Mr. Grubb, finds no difficulty in making them of admirable quality up to this size, or even fifteen inches; but with all his distinguished mechanical talent, he is believed to be doubtful of the possibility of more than doubling this last magnitude in perfect speculum metal.

Under these circumstances, too much praise cannot be given to Lord Oxmantown, who, in the midst of other pursuits, has found leisure for such researches; and by a rare combination of optical science, chemical knowledge, and practical mechanics, has given us the power of overcoming the difficulties which arrested our predecessors, and of carrying to an extent which even Herschel himself did not venture to contemplate, the illuminating power of this telescope, along with a sharpness of definition scarcely inferior to that of the achromatic.

The chief difficulties which are to be overcome in the construction of reflectors, arise from the excessive brittleness of the composition of which specula are made, and from the necessity of giving them figures which shall be free from aberration. The great mirror in the Newtonian form is (if the eyepiece and plane mirror be correct) the conical paraboloid.

It is necessary that speculum metal should possess, in the highest attainable degree, the qualities of whiteness, brilliancy, and resistance to tarnish. Lord Oxmantown has found that these conditions are best satisfied in the *definite* combinations of four equivalents of copper to one of tin; or by weight, 32 and 14.7 nearly. Metals differing from this by a slight excess of either component, are, when first polished, scarcely less brilliant, but are dimmed so rapidly that the lapse of a few days produces a sensible difference. On the other hand, some large specula of the atomic compound have been lying uncovered for years, without material injury to their polish.

But this compound is brittle almost beyond belief; a slight blow,

* A Newtonian of six feet focus, and 9.4 inches aperture, is said by Maskelyne to have shown the first satellite of Jupiter 13″ longer than a *triple* achromatic of 3.6 inches aperture. The telescope of twelve feet focus, and eighteen inches aperture, now at Oxford, showed multiple rings of Saturn.

or even the application of partial warmth, will shiver a large mass of it; though harder than steel, its surface is broken up with the utmost facility, and it has a most energetic tendency to crystalize. The common process of the founder fails with it, except for masses of very limited magnitude, as the cast cracks in the mould; and the subsequent difficulties of the annealing are such, that it has been a very general practice to use an alloy lower (containing more copper) than the atomic standard. Even Sir William Herschel was obliged to yield to this necessity. It appears from a letter of Smeaton, (Rees's Encyclopædia, Art. Telescope,) that for his 20-foot mirror of 19 inches aperture, the composition was 32 copper to 12.4 tin, and that for the 40-foot it was even lower; yet two out of three attempts to cast this huge speculum failed.

Lord Oxmantown at first endeavoured to evade the difficulty, by constructing a speculum in pieces, soldering plates of fine metal to a back of a peculiar brass, ascertained to have the same expansion; and has completed one of thirty-six inches aperture, and twenty-seven feet focal length, which performs very well on stars below the fifth magnitude, but above that exhibits a cross formed by the diffraction at the joints; and in unsteady states of the air exhibits the sixteen divisions of the great mirror on the star's disk. By diminishing the number and size of the joints it is found that these inconveniences can be diminished, so as to be scarcely perceptible; and in all probability this is the process by which the remotest limits of telescopic vision will ultimately be attained. It is, however, not necessary for instruments of even greater dimensions than this, since Lord Oxmantown has succeeded, by a contrivance as simple as ingenious, in casting, at the first attempt, a *solid* mirror of the same size; and there is no reason to suppose that it will be less effective on a much larger scale.

But however difficult it may be to obtain the rough speculum of large dimensions, it is still more so to give it a proper figure, combined with that brilliant polish which is technically called black, because it reflects no light out of the plane of incidence. In such mirrors as can be wrought by hand, they are worked by short cross strokes on the polisher, and at the same time have a slow rotation relative to it. This might be expected to produce merely a spherical figure; but by varying the length of the stroke, by circular movement, elliptic figure of the polisher, or removing portions of its pitch covering, a parobolic figure is obtained. For sizes above nine inches diameter, the work must be performed by machinery: but in all which Dr. Robinson has seen, (the most remarkable of which are those of Sir William Herschel* and Mr. Grubb,) the cross stroke is given by a lever moved by hand: and it is supposed that perfect results cannot be obtained but by the *feeling* of the polisher's action. Sir John Herschel is believed to have made important additions to his father's apparatus; and it is to be hoped he will soon redeem his promise (Mem. R. Ast. Soc., vol. vi,) of publishing his improvements.

* Dr. Robinson had the good fortune to see this at Slough, in 1830, while at work on a twenty-foot mirror.

Lord Oxmantown has in many respects deviated from the usual process. His polisher, of the mirror's diameter, intersected by transverse and circular grooves into portions not exceeding half an inch of surface, is coated, first, with a thin layer of the common optical pitch, and then with a much harder compound. It is worked *on* the mirror, and counterpoised, so that but little of its weight bears; but the want of pressure is compensated by a long and rapid stroke. The mirror revolves slowly in a cistern of water, maintained at a uniform temperature, to prevent the extrication of heat by friction. The polisher moves slowly in the same direction, while it is also impelled with two rectangular movements. The machine is driven by steam, and requires no superintendence, except to supply occasionally a little water to the polisher, and to watch when the polish is complete. By an induction from experiments on mirrors from six to thirty-six inches aperture, it was found that if the magnitudes of the transverse movements be $\frac{1}{3}$rd and $\frac{2}{100}$th of the aperture, and their times be to its period of rotation as 1 and 1.8 to 37, the figure will be parabolic: but to combine with this the highest degree of lustre, it is found necessary to apply, towards the close, a solution of soap in liquid ammonia, which seems to exert a specific action.

The certainty of the process is such, that the solid mirror of thirty-six inches aperture, after being scratched all over its surface with coarse putty, was, in Dr. Robinson's presence, perfectly polished in about six hours, and was placed in its tube for examination without any previous trial as to quality.

Lord Oxmantown has preferred the Newtonian to the Herschelian form, and, in Dr. Robinson's opinion, with good reason. In the latter, the inclination of the great mirror to the incident rays must deform the image,* and it is now known, that even with faint objects sharp definition is of high importance. It should, in fact, be a segment of a paraboloid, exterior to the axis; and though a theorem of Sir William Hamilton (Trans. Roy. Irish Acad., vol. xv., p. 97) might seem to indicate mechanical means of approximating to the figure, yet Dr. Robinson fears there would be greater difficulty in applying them than in enlarging the aperture of the Newtonian, so as to make up for the loss of light. Another serious objection is, that in the Herschelian the observer's position at the mouth of the tube must cause currents of heated air, which will materially interfere with sharpness of definition.

As to the loss of light by the second reflection, Dr. Robinson thinks it has been much overrated, and expresses a wish that a careful set of experiments were made on reflection by plane specula at various incidences, on prisms of total reflection, and the achromatic prisms, proposed as a substitute by Sir David Brewster.

As to the rest of the instrument, it may suffice to say, that it bears a general resemblance to that of Ramage, but that the tube, gallery,

* Any one who has a Newtonian telescope can verify this, by inclining a little the great mirror, so however as not to pass the edge of the plane mirror by the pencil. In Lord Oxmantown's instrument, an inclination of 11′ sensibly injures it; were it Herschelian, the inclination must be 3° 11′.

and vertical axis of the stand are counterpoised, so that one man can easily work it, notwithstanding its enormous bulk. The specula, when not in use, are preserved from moisture or acid vapours, by connecting their boxes with chambers containing quicklime, which is occasionally renewed. This arrangement (which also occurred to Dr. Robinson, and has been for several years applied by him to the Armagh reflector,) appears to be very effective in preserving the polish.

In trying the performance of the telescope, Dr. Robinson had the advantage of the assistance of one of the most celebrated of British astronomers, Sir James South; but they were unfortunate in respect to weather, as the air was unsteady in almost every instance; the moonlight was also powerful on most of the nights when they were using it. After midnight, too, (when large reflectors act best,) the sky, in general, became overcast. The time was from October 29th to November 8th.

Both specula, the divided and the solid, seem exactly parabolic, there being no sensible difference in the focal adjustment of the eyepiece with the whole aperture of thirty-six inches, or one of twelve; in the former case there is more flutter, but apparently no difference in definition, and the eyepiece comes to its place of adjustment very sharply.

The solid speculum showed α Lyræ, round and well defined, with powers up to 1000 inclusive, and at moments even with 1600; but the air was not fit for so high a power on any telescope. Rigel, two hours from the meridian, with 600, was round, the field quite dark, the companion separated by more than a diameter of the star from its light, and so brilliant that it would certainly be visible long before sunset. ζ Orionis, well defined, with all the powers from 200 to 1000, with the latter a wide black separation between the stars; 32 Orionis and 31 Canis minoris were also well separated.

It is scarcely possible to preserve the necessary sobriety of language, in speaking of the moon's appearance with this instrument, which discovers a multitude of new objects at every point of its surface. Among these may be named a mountainous tract near Ptolemy, every ridge of which is dotted with extremely minute craters, and two black parallel stripes in the bottom of Aristarchus.

The Georgian [Herschel] was the only planet visible; its disk did not show any trace of a ring. As to its satellites it is difficult to pronounce whether the luminous points seen near it are satellites or stars without micrometer measures. On October 29th, three such points were seen within a few seconds of the planet, which were not visible on November 5th; but then two others were to be traced, one of which could not have been overlooked in the first instance, had it been in the same position. If these were satellites, as is not improbable, there would be no *great* difficulty in taking good measurement both of their distance and position.

There could be little doubt of the high illuminating power of such a telescope, yet an example or two may be desirable. Between ϵ^1 and ϵ^2 Lyræ, there are two faint stars, which Sir J. Herschel (Phil. Trans., 1824) calls "debilissima," and which seem to have been, at

that time, the only set visible in the twenty-foot reflector. These, at the altitude of 18°, were visible *without an eye-glass,* and also when the aperture was contracted to twelve inches. With an aperture of eighteen inches, power 600, they and two other stars (seen in Mr. Cooper's achromatic of 13.2 aperture, and the Armagh reflector of 15) are easily seen. With the whole aperture, a fifth is visible, which Dr. Robinson had not before noticed. November 5th, strong moonlight.

In the nebula of Orion, the fifth star of the trapezium is easily seen with either speculum, even when the aperture is contracted to eighteen inches. The divided speculum will not show the sixth with the whole aperture, on account of that sort of disintegration of large stars already noticed, but does, in favourable moments, when contracted to eighteen inches. With the solid mirror and whole aperture, it stands out conspicuously under all the powers up to 1000, and even with eighteen inches is not likely to be overlooked.

Comparatively little attention was paid to nebulæ and clusters, from the moonlight, and the superior importance of ascertaining the telescope's defining power. Of the few examined were 13 Messier, in which the central mass of stars was more distinctly separated, and the stars themselves larger than had been anticipated; the great nebula of Orion and that of Andromeda showed no appearance of resolution, but the small nebula near the latter is clearly resolvable. This is also the case with the ring-nebula of Lyra; indeed, Dr. Robinson thought it was resolved at its minor axis: the fainter nebulous matter which fills it is irregularly distributed, having several stripes or wisps in it; and there are four stars near it, besides the one figured by Sir John Herschel in his catalogue of nebulæ. It is also worthy of notice, that this nebula, instead of that regular outline which he has there given it, is fringed with appendages, branching out into the surrounding space, like those of 13 Messier, and in particular, having prolongations brighter than the others in the direction of the major axis, longer than the ring's breadth. A still greater difference is found in 1 Messier, described by Sir John Herschel as "a barely resolvable cluster," and drawn, fig. 81, with a fair elliptic boundary. This telescope, however, shows the stars as in his fig. 89, and some more plainly, while the general outline, besides being irregular and fringed with appendages, has a deep bifurcation to the south.

From these and some other discrepancies, Dr. Robinson thinks it of great importance that the globular nebulæ and clusters should be all carefully reviewed, as it is chiefly from their supposed regularity that the hypothesis of the condensation of nebulous matter into suns and planets has arisen; an hypothesis which he thinks has, in some instances, been carried to an unwarrantable extent.

On the whole, he is of opinion that this is the most powerful telescope that has ever been constructed. So little has been published respecting the performance of Sir W. Herschel's forty-foot telescope, that it is not easy to institute a comparison with *that,* the only one that can fairly be made to compete with it. But there are two facts on record which lead to the inference that it was deficient in defining

power: one, the low power used, which Dr. Robinson thinks was not above 370; the other, the circumstance that neither the fifth nor sixth stars of the trapezium of the nebula of Orion were shown by it. As to light, there is no reason to believe that the composition of the forty-foot mirror was as reflective as that of the twenty foot; and if Dr. Robinson be correct in the opinion, that the latter* did not show the fifth star easily, or the sixth at all, and that it only exhibited the "debilissima" and one star near the ring nebula, then *it* has decidedly less illuminating power than eighteen, perhaps not more than fourteen inches aperture of Lord Oxmantown's mirror, notwithstanding the loss of light in that by the reflection at the second speculum.

However, any question about this optical pre-eminence is likely soon to be decided, for Lord Oxmantown is about to construct a telescope of unequalled dimensions. He intends it to be six feet aperture, and fifty feet focus, mounted in the meridian, but with a range of about half an hour on each side of it. If he succeeds in giving it the same degree of perfection as that which he has attained in the present instance, which is exceedingly probable, it will be indeed a proud achievement; his character is an assurance that it will be devoted, in the most unreserved manner, to the service of astronomy; while the energy that could accomplish such a triumph, and the liberality that has placed his discoveries in this difficult art within reach of all, may justly be reckoned among the highest distinctions of Ireland.

Lond. and Ed. Philos. Mag., Jan., 1842.

Lieutenant Becher's Horizon for Astronomical Observations at Sea or on Shore. Made by CAREY, *Optician, Strand.*

The following is a representation of the sextant, with horizon attached to it for observation:

Directions for attaching the Horizon to the Sextant.

1. Unscrew the cover of the small conical cistern *b*, without removing it from its case, and see that the surface of the oil† in it is ***rather higher*** than the aperture communicating with the inverted cistern into which the oil is to flow, when holding up the arch of the sextant to read off. Leave the cistern in its place.

2. Take the sextant from its case, and screw the telescope into its place.

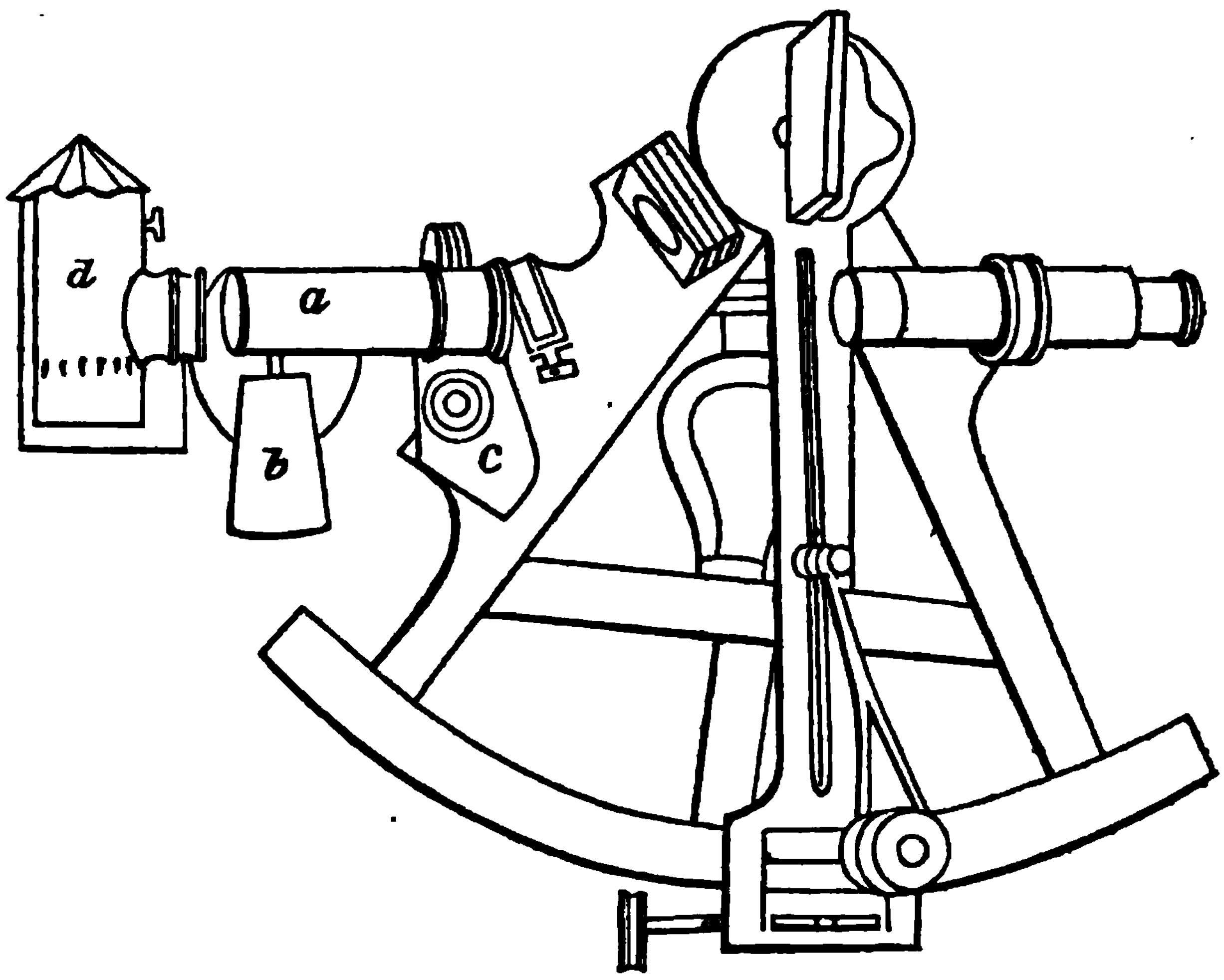
3. Fix the tube *a*, containing the horizon, in its place on the sextant, at the back of the horizon glass, the feet at the back of the plate being inserted in their sockets, and secure it there by means of the screw *c*. Raise the sliding screen at the end of the tube *a* to a proper height, so as to admit a sufficient degree of light to the tube.

4. Hook the cistern *b* in its place at the side of the tube *a*, previously immersing the pendulum in the oil which it contains. Be careful that the pendulum is previously allowed to shake about as

* In its original state, not as improved by the more perfect means latterly employed by Sir John Herschel.

† Oil of Almonds.

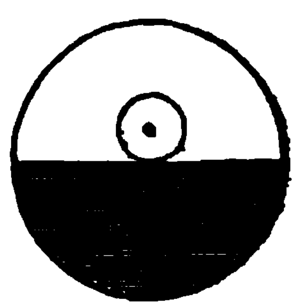
little as possible. The intention of immersing the pendulum in the oil, is to enable the observer to control its movement, which, from the extreme delicacy of its suspension, would otherwise be impossible.



5. If at night, and the lamp *d* be required, having lit the lamp,* if the light be too strong, it may be subdued by placing a screen of paper, or two if necessary, over the colored glass inside its cap, which may be unscrewed for the purpose. There is also a sliding screen† at the end of the tube *a*, which, by being moved up or down, assists in preventing too much light from passing up the tube. The light of the lamp with this also may be reduced to a sufficient strength, so as not to overpower the rays from the moon, or star, on the horizon glass of the sextant. A greater degree of shade may be necessary in bringing down the moon, or star, than afterwards for observation. The lamp being ready, slide its leg into its place at the back of the inverted cistern. The lamp will then hang in its proper place for the observation, and on holding the arch of the sextant up to read off, will preserve its vertical position.

The face of the sextant must never be inclined downward while the horizon with its cistern is attached, as in that case the oil will be lost from it.

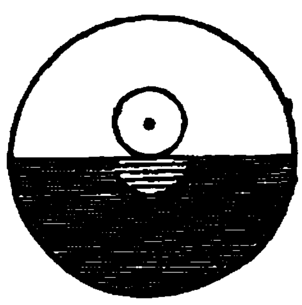
Method of Using the Instrument.—In the construction of the horizon it is assumed that when an observation is made with the horizon of the sea, that horizon forms a diameter to the field of the telescope, the sun being seen on it as in the adjacent figure. The long axis of the telescope fixed in the instrument, would then



* Four threads are sufficient for the wick.

† This screen being raised or depressed regulates the degree of light also for day observation, and at a proper height will prevent a burr on the horizon arising from too much light.

be horizontal, but for the known angle of the dip of the horizon, by which the altitude is corrected. The same position of the telescope is thus obtained:—A line for the horizon formed by the upper edge of the slip of metal, at right angles to the plane of the instrument, and in the plane of the axis of the telescope, was assumed beyond the horizon glass, and a small pendulum, carrying an arm at an angle of 90°; to which was fixed another slip of metal, the upper edge of which is at right angles to the pendulum, was placed beyond it. The pendulum having free motion in any direction, the observer has to bring the upper edge of the slip of metal attached to the pendulum in exact contact with the line above mentioned, or in other words, he has to bring the upper edges of the two slips of metal into one, and at the same time he is to make his observation by bringing down the image of the reflected object which he is observing upon it. If that object be the sun, it will appear thus:—



As the observer has thus to form his horizon at the instant of observation, in observing on board, he should get into that part of the ship where there is the least motion, and *especially in a place screened from the wind.* He may be seated or not, at pleasure, but he will find that he has more control over the movement of the pendulum when the arm holding the instrument is supported on his knee, or by some convenient part of the vessel. In observing *on shore,* he must also be careful to *screen himself from the wind.*

The observer will readily see when the upper edge of the slip of metal is below the line of the horizon, and by altering the position of the instrument, can bring the former up to the latter; but as the metal slip would prevent the horizon line being seen when the upper edge is above it, a small piece has been cut out of it, or, in other words, a notch, or aperture, has been made in this edge, so that the observer can see the horizon line in that aperture, when the horizon line is below that edge, and can rectify it by again altering the position of his instrument.

It may be right to state here that the great precision attainable with this horizon, may be attributed to the application of the lens at the end of the tube, next the horizon glass, which allows of the magnifying power of the telescope being used for the observation.

Naut. Mag. Aug. 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1841.
With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Press;* William C. Van Hoesen, Catskill, Greene county, New York, April 2.

A shaft runs across the frame of this press, and on each end of it there is a scroll wheel, which receives a chain, or rope, that passes

around a pulley at the top of the frame, then under another pulley, attached to each end of the follower, and is then made fast to the upper part of the frame. On one end of the shaft of the scroll wheels there is a large wheel, called the "power wheel," from which a chain, or rope, passes to a capstan, or other first mover.

The claim is to the "combination of the power and scroll wheels."

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2. For an improvement in the *Current Water Wheel* for Mills; Noadiah N. Hubbard, Randolph, Portage county, Ohio, April 2.

This patent was obtained for an improvement in the manner of applying chutes to the spiral current wheel. Heretofore two chutes have been placed at the forward part of the screw, so as to concentrate the current; but in all cases the current thus concentrated has been thrown upon the first thread of the screw, and the present improvement is in so placing these chutes that the current shall be directed upon different parts of the length of the thread. The patentee says: "I am aware that the force of the current to be thrown upon a wheel has been increased by chutes placed at an angle with the axis of the wheel, so as to concentrate the current upon it, and this I do not, therefore, claim as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the employment of two or more sets of chutes, or regulators, in combination with a spiral wheel, so as to throw the current upon different parts of the thread, or spiral, along its length, as described."

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3. For a method of *Wetting Flannels and other Cloths* previous to Scouring or Milling; Joseph W. Hale, Haverhill, Massachusetts, April 2.

A colander, pierced with numerous small holes, is attached to a reservoir, or tank, of water, by means of a pipe, the orifice of which is regulated by a valve, to which a cord is attached having a weight at its opposite end, for the purpose of keeping the valve opened when desired. A roller is placed at one end of the frame, and two at the other end, and the cloth in going from the single roller to the double set, by which it is drawn through regularly, passes under the colander and receives the spray from it.

The claim is to the combination of the tank, or reservoir, valve, rollers, and the colander.

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4. For improvements in the machine for *Cutting Crackers;* William Perkins, Boston, Massachusetts, April 2.

A shaft that runs across the frame of the machine gives motion to another shaft, on which is a segment cog wheel that takes into a cog wheel on an under feed roller, and from this motion is communicated to the upper feed roller, and the apron that carries the dough under the stamping apparatus, and conveys the cut crackers from under it. As the wheel that communicates motion to the under feed roller has cogs only on a part of its circumference, the dough will be fed at in-

tervals, and those intervals are made to correspond with the time required to stamp the crackers, which is effected by a cam on each end of the shaft of the segment wheel, said cam actuating a lever connected, by a rod, with a toggle-joint that operates the stamping apparatus.

The claim is to "the arrangement of machinery which gives motion to the feed rollers and endless apron, in combination with the arrangement of machinery which operates the stamping apparatus; and also to operating the feed rollers and endless apron, so that they may be alternately at rest and in motion, by means of a geared pinion, having a portion of the teeth of its circumference removed, in connexion with the other machinery intervening between said pinion, feed rollers and apron; also operating the stamping apparatus by means of a cam or cams, in connexion with the toggles and other intervening machinery."

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5. For an improvement in the *Tuyere for Forges;* Elias Kaighn, Camden, Gloucester county, New Jersey, April 2.

The ash box of the forge is to be surrounded by a flue, which has an opening to receive the nose of the bellows, and the blast passes from the flue into the ash box, through apertures made in the sides thereof, and from the ash box into the fire, through holes made for that purpose in its top plate; the ash box has a bottom which is removable at pleasure.

Claim.—"What I claim as my improvement, and wish to secure by letters patent, is the construction of the tuyere with a flue surrounding the ash box, in combination with said ash box, as set forth. Also, in combination with the foregoing, the arrangement with the upper surface of the tuyere, as the hearth of the forge, and the perforated cover for admitting air to the flame, &c., as set forth."

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6. For a *Cattle Pump;* Shively Stadon, Greenwood, Columbia county, Pennsylvania, April 2.

The patentee says:—"In my apparatus the weight of a single animal, or of more than one, is made effective in the raising of water, by their standing upon a movable platform, close to which the trough is situated, from which they are to drink, said platform being so connected with a pump as that by its depression it shall operate upon the pistons of the pump, and of course give a supply of water."

The claim refers throughout to the drawings, and is confined to the special arrangement of the apparatus, as described and represented.

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7. For a mode of *Healing Reducible Hernia;* Zophar Jayne, M. D., Greene county, Illinois, April 2.

The claim affords a sufficiently clear description of the improved mode of healing reducible hernia, and is in the following words:

"What I claim as my invention, and desire to secure by letters patent, is, first the injecting into the hernial or peritonial sac, or into the common cellular membrane, or parts in, at, or about, the abdominal

or femoral rings, or openings, wherever the hernia may occur, of an essential oil, or other stimulating or exciting fluid, for the purpose herein fully set forth, whether the same be done or injected by means of the syringe herein described, or by any other instrument adapted to that purpose; and secondly, I claim the constructing and using of a syringe for the above purpose, having a sharp-pointed beak, and a lateral opening therein, substantially as described.

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8. For an apparatus for *Heating Water and Steaming Vegetables;* Asa Munger and James S. Marsh, Auburn, Cayuga county, New York, April 2.

This apparatus consists of a boiler made of two concentric cylinders, the space between the two being for the water, and the furnace being arranged within the inner cylinder. A tubular worm is coiled within the first chamber, its upper and lower ends opening into the boiler. Two tubes branch off from the boiler, one from the top and the other from near the bottom, and connect with the bottom of a tub, from which the steam is conveyed, by a pipe, to the steaming apparatus.

Claim.—"We do not claim to be the inventors of the worm in the fire chamber, nor of the combination of the tub and boiler, without the worm, but what we do claim as our invention, and desire to secure by letters patent, is the combination of the worm in the fire chamber with the boiler and tub, for the purpose and in the manner set forth."

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9. For an improvement in the *Joints of Spectacle Frames;* Thomas Eltonhead, Baltimore, Maryland, April 2.

"It has heretofore been the practice in forming the frames of spectacles of metal to divide the end-pieces, which are soldered to the rims containing the glasses into two parts, and to connect these two parts together by means of a screw. The joint pin has been affixed to one of these parts, and the side, or temple pieces, have had the tubes through which the joint pin passes soldered to them. In my improved construction I make the end pieces solid, instead of dividing them into two parts, and into this solid piece I file a notch, to receive the end of the temple piece, which is to be adapted thereto, and a hole drilled through for receiving the joint pin."

The claim is to this manner of forming the joints, which not only abridges the labor in making them, but leaves the metals in a condensed state, it not being heated after, having been hardened under the hammer. The glasses are to be snapped in like watch glasses.

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10. For improvements in *Corselets for Medical purposes;* Alanson Abbe, Worcester, Massachusetts, April 2.

The patentee informs us that "the corselet consists of a back piece, and two side pieces, which are united to, and open from, the back piece by a hinge of metal, cloth, or other material, fixed at the top,

and in front are laced with strings. These are made, when connected, to enclose the breast, shoulders, and the upper part of the back, and are adjusted to the shape of the wearer, so as to represent the figure of the body of a well formed person. The corselet affords a support to the frame, and may be advantageously used to prevent, or remedy, distortions of the spine or chest."

The respective parts of the corselets are formed in a mould of metal, wood, plaster, or other suitable material, of the desired form. The claim is to the "mode of manufacturing corselets by forming them of any suitable material upon a mould, or between double moulds, as specified."

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11. For an improvement in the *Cheese Press;* Job Arnold, Harmony, Chataque county, New York, April 2.

The bed of this press is movable, as is also the follower. The bed slides up and down, and has a cog wheel, or pinion, at each end, the axes of which wheels have their bearings in the bed; these wheels gear into two permanent racks attached to the sides of the frame, and as the bed of the press slides up and down, the cog wheels, or pinions, are turned by the racks. There are two levers under the bed, and two above the follower of the press. The levers above, and those below, are connected together by rods, or links, joined to one of their ends, the other end of each pair being connected, by means of ropes, or chains, with the arbor of the cog wheel on each side of the bed. The fulcra of the upper levers are in the follower, and those of the lower, in the bed of the press. The result of this arrangement is, that any weight placed on the movable, or sliding, bed, will cause it to descend, which will turn the wheels, and by means of the ropes, or chains, on their arbors, the ends of the levers to which the chains are attached are drawn together, and as their opposite ends are connected together, the follower is forced down upon the cheese, or other articles placed on the bed.

Claim.—"What I claim as my improvement, and wish to secure by letters patent, is the combining of two sets of levers, one set being arranged above the follower, and the other below the movable bed, or press bottom, with the aforesaid follower and movable bed, and said levers being connected and operated as set forth."

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12. For improvements in the *Rotary Steam Engine;* Isaac N. Whittlesay, Vincennes, Knox county, Indiana, April 2.

"The general construction of my improved engine," the patentee says, "is similar to that of some others which have been heretofore constructed, but I have made such improvements thereon as are intended and calculated to obviate some of the difficulties which have been experienced in its action. The principal of these improvements consist in the employment of the steam to open and close the sliding valves, and in the arrangement of some of the other parts by which its action is governed."

Within a hollow case, of the usual construction, "revolves a drum, which carries two valves, to be operated by the action of the steam, which action causes the said inner drum, with its shaft, to revolve in the ordinary way. The valves, which are connected together by a rod, slide into recesses made for them in the drum, which is hollow towards the shaft, for the reception of a disk attached to one of the heads of the outer drum. This disk is at some distance from the head plate to which it is attached, and the space between them is divided by a partition, so as to divide the induction from the eduction pipes. The steam introduced through the induction pipe passes into the hollow space of the inner drum, acts against the inner end of one of the valves, which is thus forced out, and then passes through a hole by the side of the valve into the steam chamber, and impels the valve and inner drum by its reaction on a stop attached to the inner periphery of the outer drum. The openings which admit the steam into, and allow it to escape from, the drum, must be so regulated as to correspond with the position of the stop. The steam may be made to enter the space between the two drums on either side of the valves by a shifting plate, which opens an aperture on one side as it closes the one on the other side, so that by shifting this plate, the motion of the engine may be reversed. The claim refers throughout to the drawings. It is confined, however, to the manner of protruding the valves by the elastic force of the steam, acting behind them by an arrangement of parts similar to that above described; and also to the manner of reversing the motion of the engine, by shifting the plate, as above indicated.

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13. For an improvement in the machine for *Cutting Staves;* Cephas Manning, Acton, Middlesex county, Massachusetts, April 10.

This machine cuts the staves from a block of wood by means of a knife, or knives, attached to two revolving disks on a shaft. Between the knife and the shaft there is a bar, extending from disk to disk, on which two holders are placed, armed with the necessary cutters for forming the bevel and groove, and for cutting off the ends of the staves. The position of these holders may be shifted on the bar, so as to adapt them to any length of staves, they being made fast by means of a set screw. The bar should be so situated, with reference to the cutter, which separates the stave from the block, as to cut the bevel, &c., before the stave is cut from the block.

The block is moved forward by means of levers, palls, and a ratchet wheel, which need no description, and these are so arranged as to be thrown in and out of gear, at pleasure, by the aid of levers and catches.

Claim.—"I claim the arrangement of the holders of the cutters for forming the bevel and groove, and for cutting off the ends of the staves, on curved or straight bars, or similar contrivances, so that they may be adjusted to cut staves of different lengths, and preserve the bilge of the stave, as described."

The particular arrangement of the machinery by which the pall and ratchet wheels are thrown out of gear, is also made the subject

of a claim, but this we omit, as the drawings would be necessary to an understanding of it.

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14. For improvements in *Lamps* for burning Chemical mixtures, or compositions of Alcohol, Spirits of Turpentine, &c.; Benjamin F. Greenough, Boston, Massachusetts, April 10.

The claims express the character of the improvements sufficiently to enable any one acquainted with the construction of lamps to understand them. They are as follows:

"Having described my invention, I shall claim—first, the placing of a shoulder on the rod by which the button is supported, said shoulder being so constructed as to set loosely on, and adapting the button to a projection on said shoulder in a similar manner, by means of which combined arrangement, the rapid oxidation of the disk (which is made of platina,) is prevented, as described. Second, guiding the adjusting rod of the button, by passing the same through a tube, whose lower end is attached to the bottom of the oil cup, or otherwise similarly arranged, the said tube extending upwards into and through the central part of the interior of the burner, the whole being for the purpose of permitting an uninterrupted current of air to act on the inner surface of the flame. Third, the combination of an adjusting cone (applied to the exterior tube of the burner by a circular spring, or other contrivance substantially the same, by which its altitude is regulated,) with the adjusting button, or one whose elevation may be varied at pleasure; the whole being arranged substantially in the manner and for the purpose described. Lastly, I claim a cone constructed with an extended cylindrical base, having a series of radial holes through the circumference of the same, and made so as to be adjusted in height on the exterior tube of the burner by means of a circular shelf and spring, in combination with a movable button, whose rod is supported and guided by a tube, connected with the oil cup, and whose elevation can be regulated by a screw, or other suitable contrivance, the whole being constructed and arranged for the purpose and in the manner described."

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15. For a machine for *Harrowing and Planting Seed;* John F. Schermerhorn, and Rufus Porter, City of New York, April 10.

In an appropriate frame there is a cylinder, armed with several rows of curved teeth, which enter, and carry up, the earth, and this is knocked off by the teeth of a smaller cylinder, which pass between the sets of teeth on the main cylinder. At a short distance back of the said small cylinder, there is a planting cylinder, hoppers and coverers, to contain, drop, and cover the seeds. For the purpose of lifting the forward part of the machine, to clear the teeth from the ground, there are two shoes jointed to the frame, and to two levers that are connected together by a bar, by which arrangement the shoes may be pressed down and made to lift the machine.

Claim.—"What we claim as our invention, and wish to secure by letters patent, is combining the large, or cutting, cylinder, and the re-

volving shaft of spiders, arranged as set forth in an open frame, so constructed as to allow of their application to the purpose specified, and described. We also claim, in combination with the foregoing, the hoppers and planting cylinders, the whole being constructed as described. Lastly, we claim, in combination with the cylinder and shaft of spiders, arranged as set forth, the mode of raising the frame and cylinders from the ground by means of the shoes and levers; the whole being combined, arranged, and operating substantially as described."

16. For an improvement in the *Truss* for the cure of Prolapsus Uteri; John A. Campbell, Lima, Livingston county, New York, April 10.

There is in this truss a body spring, of the usual construction, furnished with a back pad. The abdominal pad is connected with the body spring by means of a semi-elliptic spring, which is attached to the rim of the pad at one side, permanently, and at the other by a screw which passes through a slot in the elliptic spring, so as to allow play thereto. To the middle of this semi-elliptic spring, and to the upper part of the pad rim, is attached the adjusting plate, which forms the connexion with the body spring, the screw which connects them being passed through a slot in the said plate, for the purpose of adjustment.

Claim.—"I do not claim as my invention either the abdominal or the back pad, neither do I claim the body spring; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement of the semi-elliptic spring and the spring adjuster, in combination with the abdominal pad, body spring, and back pad, for the purpose of regulating the pressure of the abdominal pad, constructed and operating as described."

17. For an improvement in the *Window Blind Fastener;* Sylvanus Fansher, Southbury, New Haven county, Connecticut, April 10.

This apparatus consists in part of a bar, which is jointed to the shutter, near its hinged edge; the outer end of this bar has a loop which passes on to staples attached to the window sill, and to the shutter—those on the shutters are near the edges that lap over each other, and correspond, when the shutters are closed, with two on the sills, so that the loop on the end of the bar may pass over and embrace the two, and thus secure the shutters. When it is desired to keep the shutters open, the loops on the bars are passed on to staples near the sides of the window.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the above described mode of fastening window shutters and blinds, which consist of the bar attached by a joint to the shutter, in combination with the two sets of staples on the window sill, and the one set on the shutters.

18. For an improvement in the method of *Casting Hinges;* Samuel Wilkes, Darleston, Stafford county, England, April, 10,1841. Patent to run fourteen years from the 21st of January, 1840, this being the date of the English patent.

This patent is for a mode of casting the two sides, or flaps, and the hinge joint on to an axis at the same operation. A wrought iron joint pin is put into the mould, and, in casting, the metal is prevented from running together at the joints, by iron or paper washers slipped on the joint pin; and the junction of the leaves between the joints is prevented, by means of iron clips, put into the flasks.

Claim.—"What I claim is the mode of manufacturing hinges, by casting the two flaps, or sides, with their hinge joints at one time, on to a suitable axis, as described."

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19. For an improvement in the machine for *Pressing Straw Braid;* Henry H. Robbins, Middleborough, Plymouth county, Massachusetts, April 10.

For an explanation of the leading features of this improvement, we refer to the claim only, which is in the following words, viz:—"I claim as my invention," says the patentee, "pressing straw braid by means of a polished revolving metallic wheel, or roller, in combination with a hollow metallic box, the upper side, or face, of which is concave and polished, and which is heated by the introduction of steam, the concave face being pressed against the periphery of the wheel by means of a bent lever and weight."

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20. For an improvement in the *Screw Propeller,* for propelling Boats, Vessels, &c.; Ebenezer Beard, New Sharon, Franklin county, Maine, April 10.

A description of the peculiarities of this improvement could not be rendered clear without the drawings; but the claim will enable those who are acquainted with the screw propellors heretofore made, to understand this modification.

Claim.—"I shall claim" "curving the wings of the screw paddles, or propellers, in a direction perpendicular to the shaft, or axis, of revolution, as described."

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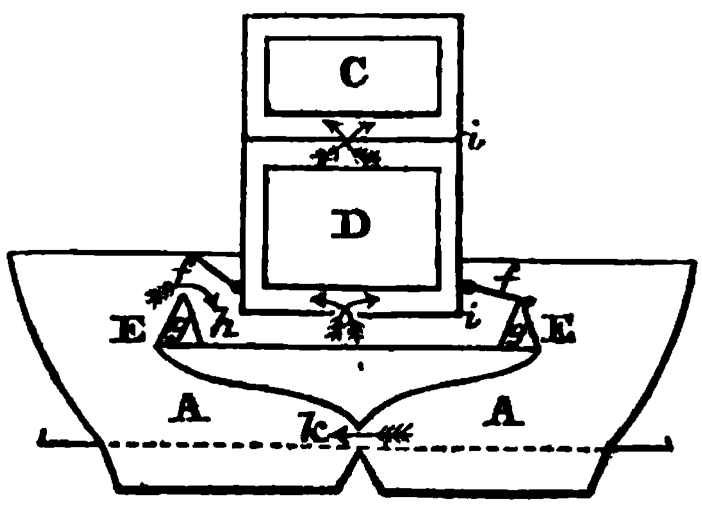
21. For improvements in the *Cooking Stove;* M. C. Saddler, Brockport, Monroe county, New York, April 10.

In this stove there are two fire chambers, A A, (see diagram,) placed side by side, and two ovens, C D, one above the other, and placed above the fire chambers, the side flues of the oven being above the middle of each fire chamber, and that portion of each fire chamber which is not covered by the ovens, is provided with boiler holes in the usual way. The bottom of the lower oven



is protected from the action of the fire by a cold air flue, as will be seen by reference to the diagram, at E E, the bottom plates of which are curved down where they meet in the middle between the two fire chambers, and leave but a narrow space, *k*, between them and a projection from the bottom plate of the fire chamber. The valves, or dampers, *f*, *f*, are hinged to the side plates of the ovens, and bear, when closed, on the top of hollow valve seats *g*, *g*, through which cold air circulates, for the purpose of protecting them from the injurious action of the fire; but when the dampers are open, a flue is formed by the surface of the damper, the top plate of the fire chamber, and the side of the oven, as at *h*, into which cold air is admitted for the same purpose.

Between the top plate of the cold air chamber and the bottom of the lower oven, and between the top of the bottom, and the bottom of the top oven, there are guard plates, *i*, *i*, which admit the draft under the middle of the bottom of the oven. Fire can be made in one or both fire places; when one only is used, one of the dampers must be closed.

Claim.—"I do not claim to be the first to have constructed a cooking stove with two fireplaces, or chambers of combustion, in either or both of which fire might be made, this having before been done, but not under an arrangement and combination of parts similar to that adopted by me; but what I do claim in the above described stove, and desire to secure by letters patent, is the manner of constructing and of placing the cold air flue between the chambers of combustion and the ovens situated above and between said fire chambers, as herein set forth. I claim, likewise, the making of the valve seats hollow, and the admitting of air into them, in the manner and for the purpose described; and also the protecting of the dampers, by constituting the spaces formed by them, when opened, into cold air flues, in the manner set forth. I also claim the manner of arranging the oven flues as described—that is to say, the dividing of the bottom flue plates, which I generally denominate the guard plates, into two parts, so as to cause the heated air to enter the flues along the middles of the bottom oven plates, and to ascend on each side of the ovens, as herein made known."

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22. For improvements in the machine for *Planting Corn*, Sugar Beet, and other seeds; Ezra L. Miller, Brooklyn, New York, April 10.

On the forward end of the frame of this machine, and at each side of it, there is a hopper, furnished with a slide for receiving and dropping the seeds. The slides are connected by a small chain with a spiral spring, inclosed in a tube, which draws back the slides after they have been pushed forward by cams on the wheels of the machine, which strike against a lever in connexion with each slide. When the slides are relieved from the cam, they are drawn back by the spring, and strike against a stop, which gives a jar to insure the dropping of the seeds. The strike, which brushes off the surplus seeds from

the top of the slide, as it is moving forward to drop them, is composed of a number of strips of quills, held together in a clamp. An agitator is employed to insure the entrance of the seeds in the hole in the slide, and to prevent them from arching over, which consists of a rod, with a brush at one end, which is jointed, and by means of a rod, or standard, attached to, and moving with, the slide and a connecting rod, this brush, or agitator, is moved over the hole in the slide.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is—first, the manner in which I have combined the reciprocating slide, the stop, the cams on the wheels, and the spring, or springs, by which the slides are operated; by means of which combination, an alternately slow and rapid motion is given to the reciprocating slide, by the sudden arresting of which against the stop, a concussion is produced when the seed vessel is directly over the dropping tube, which insures its falling. I also claim the particular construction of the spring strike, formed of elastic quills, and affixed and operating substantially as described. I also claim the manner of constructing and operating the agitator, as described."

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23. For a mode of *rendering Casts and other articles Water and Air Proof;* Samuel Goodwin, city of New York, April 16.

This invention "consists in making any article that can be cast, or moulded, perfectly impervious to air, moisture, or decay, by saturating it in a heated composition of oil and rosin. What I claim as my invention, and desire to secure by letters patent, is the mode of rendering articles manufactured from cement, composed of the materials specified, (sand and plaster of paris,) or any others substantially the same in their combination, impervious to air, moisture, or decay, by boiling them in a mixture of oil and rosin, as described." Casts of plaster of paris, and its compounds, have often been saturated with wax, drying oils, and varnishes, and in what particular the proposed process differs from these, we do not know, except it be in the *boiling*, which, we apprehend, will be apt to decompose the plaster, by separating from it its combined water.

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24. For an improvement in the *Indicator, or Steam Gauge,* for ascertaining the pressure of steam in a boiler; George Bradley, Paterson, Passaic county, New Jersey, April 16.

This apparatus consists of a piston, which works in a cylinder open at one end to the atmosphere, and at the other to the steam in the boiler, and this is connected, by a slide, to a spring balance, provided with a graduated scale and pointer, to indicate the pressure of the steam in the boiler above that of the atmosphere.

Claim.—"What I claim as my invention, and not previously known nor used, is an oscillating piston, to which is attached a metallic spring, in such a manner as to counterbalance any pressure that may be communicated from the steam boiler to such piston, and at the same time show what that pressure is by means of an index."

25. For an improvement in the *Cooking Stove;* John B. Bissell, Otsego, New York, April 16.

This stove has two fire chambers—one in front of, and the other above, the oven. When the front alone is used, the draught passes, by means of raised flues, under the boilers, through the upper fireplace, and out at the stove pipe; or, by means of a rolling damper, which closes the opening to the upper fireplace, and at the same time opens the flues around the oven, it may be carried down in front of the oven, under it, and then up the back, to the stove pipe. The draught from the upper fireplace may pass either directly out of the stove pipe, or down the back of the fireplace, over the oven, down the front, under the bottom, and up the back, to the stove pipe.

Claim.—"I do not claim the invention of the raised collars, or rolling or slide dampers, or either of the fire chambers, they, severally, having been used before, in different stoves; but I do claim as my invention and improvement, the method of arranging and combining the upper and lower fire chambers with each other, and with the flues around the oven, by means of flues governed by dampers."

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26. For improvements in *Saw Mill Dogs;* Damon A. Church, Friendship, Alleghany county, New York, April 16.

In this case we omit the claim, as it refers throughout to the drawings, and could not be understood without them. It is limited to an arrangement of levers for withdrawing the dogs by the motion of the carriage, and also to a particular arrangement of the parts for setting the log.

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27. For an improvement in *Knife Handles;* Zena K. Murdock, Meriden; New Haven county, Connecticut, April 16.

The subject of this patent is a new mode of making handles for table cutlery, from plates of ivory instead of from solid pieces. Four such plates are to be put together by tongues and grooves, and held in place by a cap at the back end, and by a ferule at the end which receives the knife or fork.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode or method of constructing handles for table cutlery from plates of ivory, or bone, &c., combined substantially in the manner specified."

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28. For an improvement in the machine for *Cleaning and Drying Feathers;* Nathaniel L. Manning, Boston, Massachusetts, April 16.

The patentee says: "I shall claim as my invention the mode herein described of drying and cleansing feathers, by means of carbonic acid gas, hot air, and other products of the combustion of charcoal, or other suitable fuel, introduced among the feathers during the process of whipping and separating them from each other, in the manner described. Second, I claim whipping and separating the feathers from each other, by means of bows and sails applied to a revolving shaft,

which shaft shall remain in one position, while revolving, and the feathers be brought under the action of the same, in the box in which said shaft revolves, in any convenient manner, or said shaft may be moved over the mass of feathers, and back and forth throughout the box, by means of a band and pulley, or a chain belt and cogged pinion, operated as above described. Third, I claim closing the elongated slots, or apertures, in the sides of the box, so that none of the feathers may escape, or impede the operations of the machinery, as the revolving shaft is moved to and fro, by means of a band laying over the same, and traveling over drums, or pulleys, and operated by the revolving shaft, as set forth."

We deem it unnecessary to add any explanatory remarks, as the alleged improvements are sufficiently pointed out in the above; we have no doubt that this machine will be equally good with some of the previously patented feather dressers, which have had their day, and are almost forgotten.

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29. For an improvement in the *Screw Wrench;* Loring Coes, Springfield, Hampden county, Massachusetts, April 16.

The following is the claim made under this patent. "Having thus described my invention, I shall claim combining the screw, which operates the sliding jaw (and which is placed on one side of the shank upon which the said jaw moves, and to the extremity of which the hammer jaw is applied;) with a female screw formed through a projection from the sliding jaw, situated on the same side of the shank with the adjusting screw; the said adjusting screw to be suitably supported, and to have a turning, or milled, nut thereon, a portion of whose edge, or periphery, shall pass into a notch or other similar contrivance, formed in, or upon, the side of the shank of the wrench, so that the said adjusting screw may be always kept in the same position, and when revolved, cause the lower jaw to slide on the shank, as described."

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30. For improvements in the *Pump;* Jesse Reed, Marshfield, Plymouth county, Massachusetts, April 16.

Claim.—"Having described my improvement in pumps, I shall claim: First.—The method of confining the lower valve to its seat, so that it may be easily removed therefrom, for repair or other purpose, by means of a spring, to which the valve is connected, and which rests on the upper surface of the bottom of the pump barrel—its end pressing against the interior circumference of the barrel, the same being arranged and constructed substantially as described. Second.—I claim the particular mode, above described, of constructing a pump, with an air chamber below the lower box, into the bottom of which chamber the pipe communicating with the cistern, or well, is inserted, or connected, in any proper manner, and through which chamber another pipe passes, the lower end of which is situated immediately over the top of the induction pipe, while the upper

end is joined, or connected, to the top of the chamber, the said pipe communicating at top, with the pump barrel, the lower valve of the same being immediately over and upon its ends, and at bottom, by any sufficient number of holes, or orifices, bored through the same, with the said chamber, through which it passes, the whole being arranged substantially as described, and for the purpose of permitting the water, from the cistern, or well, to rise into the chamber during the downward stroke of the piston, or upper box, and otherwise operating in manner as herein before explained and set forth; meaning in the above, not to claim the addition of an air chamber to the lifting pump, but my particular mode of constructing and applying the same, as described. Third.—I claim the method of adjusting the pump handle, or lever, which raises and depresses the upper pump box, by attaching said lever to the top plate, or cover, of the pump barrel, and arranging said plate, or cover, as described, so that it may be turned around, and fixed in position by a screw or other similar, or suitable, contrivance, the whole being constructed and operating substantially as described."

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31. For an improvement in the *Dyeing Machine;* William Spencer, Lowell, Middlesex county, Massachusetts, April 17.

This improvement in the dyeing machine has been added to a patent granted on the 25th of September, 1838, noticed in this Journal, vol. xxiv, 2nd series, page 168; for an explanation of the principle of the machine, the reader is referred to that article.

Instead of one vat, as described in the original patent, there are to be several successive vats, and a slatted reel for each vat, said reels being so arranged that, by means of counter weights, cords, and pulleys, they may be drawn out of the vats. The yarn passes from the beam over a small slatted reel on the edge of the vat, down through the dyeing liquor under the slatted reel, then up over another small reel on the other edge of the vat, then through a comb down under a reel between the vats, over a small reel on the edge of the next vat, and so on through the series. When the operation commences, the liquor being strong, some of the reels are drawn out, so that the yarn is not passed through all the vats, and as the dyeing liquor becomes weaker, the reels are let down into the vats, one after the other. The yarn is passed under reels between the vats, to expose it to the action of the atmosphere. The claim made is to the variations in this arrangement, from those described in the original patent.

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32. For an improvement in the manner of constructing the rods of *Lightning Conductors;* Justin E. Strong, Boston, Massachusetts, April 19.

The claim made under this patent is to "the mode set forth of connecting the joints of lightning conductors, and constructing and applying the discharging points thereto; that is to say, by forming each point with a shoulder and a shank in rear of the same, the said shank

having a screw cut on the same, and passing through one of the rods, and being screwed into the other, the whole being arranged and applied to a building as described."

33. For an improvement in the *Smut Machine;* William B. Palmer, Rochester, Monroe county, New York, April 19.

In this machine, two frustrums of cones, made of perforated sheet metal, are arranged one within the other, the interior frustrum being made to revolve. The upper surface of the head of the inner cone, and the inner surface of the head of the outer one, are fluted, for the purpose of rubbing the grain; and within the inner cone, there is a fan which revolves in a direction contrary to that of the cone. The grain is fed in from the top and rubbed between the surfaces of the two cones, and is at the same time subjected to the action of a current of air, created by the fan.

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the following improvements, viz: The combination of the fan with the cones, in the manner set forth; the internal cone being perforated, and constructed with a fluted head, and having the fan arranged and moved within it, as described; also the combination of these, so constructed and arranged, with the external cone."

34. For an improvement in the *Screen for Sifting Coal;* Elisha D. Payne and Enos Woodruff, Newark, Essex county, New Jersey, April 19.

The patentees say,—"Our improvement consists in a new method of hanging the sifting box by means of two gudgeons, or by a single rod, or axle, and providing a guide board on the sifting box, to guide the material to be sifted on to the head of the screen. We give to the screen a peculiar shape, which forms the under part of the sifting box, and incline it from its head to its delivery end to suit the nature of the material sifted. The axle, or gudgeons, we place about one-third of the way from the head of the sifting box to the tail, or delivery end, and we agitate the sifting box by raising or depressing the one end, by means of a cam toothed wheel, with a spring at the other end to return the motion against the toothed wheel, so that it is vibrated vertically, like a tilt hammer."

"What we claim, is combining the inclined guide board with a box, or case, for receiving the material to be sifted, constructed as described; said box consisting of side and end pieces, and an inclined bottom, pierced with apertures for sifting the coal, or other materials, the whole being arranged as set forth. Also, in combination with the sifting box thus constructed, an exterior case for containing the same. Lastly, in combination with the sifter box and external case, the method of suspending and operating the shoe by means of the axle, the spring, and wheel, the whole being constructed and operating in the manner set forth."

35. For an improvement in the *Seal Press;* A. Ralston Chase, Cincinnati, Ohio, April 19.

In this press the seal is to be attached to a guide rod, around which is coiled a helical spring, for the purpose of drawing up the guide rod and seal, after they have been relieved from the action of an eccentric, or cam, on the end of a hand lever, by which the impression is given.

The claim is confined to the "combination of the lever, having an eccentric formed on its end, with the guide rod, and helical spring, as described." The difference between this seal press and many others previously in use, is very small, and its superiority to them by no means obvious.

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36. For an improved mode of producing a *Black Color for Dyeing;* John D. Prince, Lowell, Middlesex county, Massachusetts, April 24. (See Specification.)

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37. For an improvement in the *Spring Lancet;* John M. Van Osdel, Chicago, Cook county, Illinois, April 24.

The stem of the lancet which is the subject of this patent, is jointed to the back part of the inside of the case, and by means of two bridle pieces, it is connected to one end of a rod, which passes out through the back of the case; and around which is coiled a helical spring, for the purpose of drawing back the said rod. The two bridle pieces constitute what is called the "toggle joint," the vibration of which from one side to the other, which is effected by means of the rod and spring, will cause the lancet blade to advance so as to enter a vein, and then recede. The lancet is set by means of a nut on the rod which regulates the amount of vibration of the toggle-joint.

"What I claim as my invention, and desire to secure by letters patent, is the giving a reacting motion to the blade of a spring lancet, by the combination of the spiral spring and the compound cranks, or bridle pieces, as set forth. Also, I claim the method of setting the lancet by simply drawing back the rod, as described."

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38. For an improvement in *Boots and Shoes;* Ansel Thayer, Braintree, Norfolk county, Massachusetts, April 24.

"In boots and shoes as improved by me, there is not any outsole of leather from the instep to the back of the heel, this part being occupied by a plate, or fixture, of metal, which I denominate the metallic shank, which laps over the rear end of the outsole, and is continued back in one piece, so as to form a portion of the heel."

"What I claim as constituting my invention, and desire to secure by letters patent, is the employment of a metallic shank, extending along the instep and heel of boots and shoes, in place of the outsoles of leather, said shank being formed and affixed substantially in the manner set forth."

39. For a method of *Increasing the Draught of Chimneys;* Joseph Hurd, Jr., Stoneham, Middlesex county, Massachusetts, April 24.

Through the horizontal part of such a cowl as is usually employed on chimney tops, and which is provided with a vane to give it a proper direction, a horizontal shaft passes, which has a wheel on each end, that at the open end of the cowl being provided with radial vanes, parallel with the axis of the wheel, so that by its centrifugal action on the air, it tends to generate a vacuum in the chimney, and thus form a draught; and that on the closed side is provided with inclined vanes, against which the wind acts, and by which the whole is operated, or put in motion.

Claim.—"I shall claim discharging the smoke from a chimney, or the impure air of an apartment from the same, by a discharging wheel, constructed and revolved as described, and also by means of a cowl having a horizontal shaft passing through it, upon the front end of which a wind wheel is affixed, and upon the rear end, and over the mouth of the cowl, a discharging wheel, to be set in motion by the action of the wind on the former, the proper position of said cowl, with respect to the wind, being regulated by a vane suitably attached to, and which turns, the same, the whole being arranged and operating substantially as set forth."

There are several different cowls, or chimney caps, which operate to advantage when there is a good breeze of wind, but we do not know of one which is effective at any other time; they tend, in many instances, rather to obstruct than to aid the draught when the atmosphere is still; this, we apprehend, is unavoidable.

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40. For an improvement in *Iron Bridges;* Squire Whipple, Utica, Oneida county, New York, April 24.

The claim under this patent gives a sufficiently clear description of the nature of the improvement, and is as follows:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of sustaining the flooring of bridges by iron trusses containing cast-iron arches, formed in sections, or segments, in combination with diagonal ties, or braces, to sustain the form of the arch against the effect of unequal pressure, (with or without vertical posts, or rods,) and wrought-iron arch strings, or thrust ties, to sustain the thrust and prevent the spreading of the arch, in case the abutments and piers be not relied on for that purpose. Also, the divergence, or horizontal expansion, of the arch, from the middle portion to the ends thereof, in wooden trusses, or arches, as well as in those composed of iron."

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41. For an improvement in the *Window Fastener;* James P. McKean, Washington, District of Columbia, April 24.

The family of window fasteners is a very large one, not fewer than forty patents having been obtained for devices for this purpose; it would be no easy task, therefore, to compare a new comer with its

forerunners; this, therefore, we shall not attempt, nor shall we describe the features of that before us any further than they are given in the following:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the bolt working through the lower rail of the shutter, near one edge, with the bar, or lever, having a handle (passing through to the inside of a shutter) near the other edge, for the purpose, and in the manner, described."

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42. For an improvement in the *Smut Machine*, for clearing grain from smut, garlic, &c.; James Coppuck, Mount Holly, Burlington county, New Jersey, April 24.

The outer case of this machine consists of a truncated cone, with the inside fluted, or channeled. The flutes, or channels, are made by alternate staves of about three inches at the greater diameter of the truncated cone, and gradually diminishing, and about an inch and a half deep at top, and gradually diminishing to nothing. A curved dish, with a hole in the centre, and a bridge tree, for the support of the spindle of the fan, is attached at the bottom, or small end, of the cone. A conical fan, with a cap, revolves within this case, the cap being equal, in diameter, to the larger inner diameter of the case; and the whole is covered with a semi-spherical cap, which is provided with a flue for every flute, or channel, in the case, through which the grain is fed. The current of air which moves from the smaller and towards the larger, meets the grain as it descends in the flues, and this, together with the action of the fans and flutes, or channels, separates the dirt, &c., from the grain.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of constructing the cylinder, or truncated cone, with flutes, as described, in combination with the revolving fan, or wings, acting as beaters, and to produce a current of air through the machine, the whole being constructed and operating substantially in the manner set forth."

---

43. For an improvement in the *Winnowing Machine;* Zalman Rice, Lyons, Wayne county, New York, April 24.

In addition to the common blower, or fan wheel, of the well-known wheat fan, there is, in this machine, a second fan wheel, which throws a current of air downwards on an additional screen, or sieve, which at the same time receives a current of air from below, from the common fan wheel; below this sieve, or screen, two or more screens may be added at pleasure. "The screen is covered with wire that will admit the grain to fall freely through it upon a second sieve, or screen; as the upper sieve receives the wind directly on its upper surface, from the small fan wheel, the smut balls, white caps, and other matters which are larger than the grain, are thereby effectually blown off from it. Excepting towards its front edge, the lower side of the screen is defended from the action of the wind from the large fan

wheel, by a piece of thin wood, a sheet of metal, or other suitable substance, fastened on to the lower side of its frame, and extending from the back to within a few inches of the front of it. This piece I call a conductor, as it carries, or conducts, the whole of the grain to the opening through which it passes, and falls upon the screen below it."

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the manner of employing a second fan wheel, operating in a direction the reverse of that usually employed, so as that the current of wind from it shall be directed downwards in the manner, and for the purpose, set forth. I also claim the using of the device which I have denominated a conductor, on the lower side of the upper screen, and attached to the frame thereof, and also, if preferred, on the lower sides of the frames of the sieves, or screens, used for sifting, or screening, in such a machine as herein described and made known; said conductors being so placed as to adapt them to the carrying of the grain, or other matters, either backwards or forwards, according to the directions required by the inclinations given to such screens, or sieves."

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44. For an improvement in the *Saw Gin, for Ginning Cotton;* C. A. McPhetridge, Natchez, Adams county, Mississippi, April 24.

Instead of the grate bars in the ordinary saw gin, between which the saws pass, and draw the cotton, to separate the fibre from the seeds, they, in this machine, pass in grooves made for that purpose in a roller placed above the saw cylinder.

Claim.—"What I claim as my invention, and which I wish to secure by letters patent, is the peculiar arrangement of the roller, having grooves into which the saws work, in combination with the saws, for the purpose, and in the manner, described."

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45. For an improvement in the apparatus for *Destroying Canker Worms;* Daniel Newhall, Lynn, Essex county, Massachusetts, April 24.

This patent is for an improvement added to the patent granted on the 31st day of October, 1840, and noticed in this Journal, vol. ii, 3rd series, page 406.

For the purpose of preventing the oil, or other liquid, used in the trough for destroying the worm, from overflowing, in consequence of the percolation of water into it, there is to be an inclined pipe, the lower end of which reaches to the bottom of the trough, and the upper end within a short distance of the height of its edge. Sufficient water is first put into the trough to cover the end of the pipe, and the oil, or other fluid, is then poured in. When rain falls, and passes into the trough, the superabundant water will flow over at the upper end of the inclined pipe, and the oil thus be preserved from escaping.

Claim.—"Having thus described my improvement, I shall claim, as my invention, a pipe, or tube, arranged substantially as described, in combination with the trough, for the purpose of preventing the oil,

or destroying liquid, from being displaced, or forced out of the trough."

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46. For improvements in the *Cooking Stove;* Hiram Blanchard, Aquackamonk, Passaic county, New Jersey, April 27.

The improvements that constitute the subject of this patent, is in that kind of cooking stoves that have the oven back of the fire chamber, and an air chamber between the two. The guard plate which forms the false back of the fire chamber has a "cross piece," or flanch, projecting from it, that forms the bottom of the air chamber. The upper part of this guard plate is bent back to form the top of the air chamber, and its lower part bent forward to prevent coals and ashes from passing into the flue, under the oven. The upper part of the fire chamber is inclined forward, and provided with apertures and a register to carry off the smoke, &c., when articles are cooked on the hearth.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is, 1st. Constructing the guard plate with a cross piece to form the bottom of the air chamber, in combination with the vertical shield, or continuation of the guard plate, extended below said cross piece, for the purpose of preventing coals, &c., passing into the flue under the oven, the whole being constructed as before described. 2nd. Constructing the front of the stove with an inclination forward and above the hearth of said stove, in combination with the apertures governed by a register, as set forth, for the purpose of receiving the smoke, &c., when articles are cooked on the front hearth, or ashes, when the fire is raked, as described."

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47. For an improvement in *Piston Rods of Steam Engines;* John R. St. John, Cleveland, Cuyohoga county, Ohio, April 27.

The rod of the piston, which works in the cylinder, as described in the specification of this patent, is hollow, its outer end being attached to a slide, and in it there is a small hollow piston, to the rod of which the connecting rod, from the crank, is jointed. Two such must be employed, with two cranks placed at right angles. By this arrangement, a crank of greater capacity than the length of the cylinder may be employed. As a modification of this arrangement, the patentee proposes the connecting of the slide of the piston rod, by means of a toggle joint, with the slide to which the connecting rod is jointed.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of two or more compound piston rods working in appropriate cylinders, as set forth, with an equal number of cranks arranged on the shaft, to which the power is communicated, the whole being combined, constructed, and operating substantially in the manner, and for the purpose, described. The said compound piston rod being my own invention, but not claimed for reason of being effective only in a combination of two or more, as claimed and set forth."

Specifications of American Patents.

Specification of a patent granted to John D. Prince, *Lowell, Massachusetts, on the 24th of April*, 1841, *for a new mode of producing a Black Color in Dyeing.*

To all whom it may concern: Be it known that I, John D. Prince, Jr., of Lowell, in the state of Massachusetts, have invented, or discovered, a new and improved mode of producing a black color, in the operation of dyeing, by a combination of ingredients not heretofore employed in the manner, and for the purpose, discovered and adopted by me. The common mordant used in dyeing various articles of a black color is, as is well known, an acetate of iron; and the best effect of this mordant is obtained when, by the action of the air, a mixture, or compound, of the protoxide of iron is formed on the substance to be dyed. I have ascertained, by repeated trials, that the proto-sulphate of iron (copperas) may be advantageously substituted for the acetate of iron, as a mordant, by bringing it into that state which shall coerce it to deposite these two ingredients, the protoxide and peroxide of iron, on the goods under treatment. There are various articles which effect this purpose to a certain extent, but that which I found to do so in the most perfect manner, is the arsenious acid (arsenic) mixed, or combined, with the proto-sulphate. The proportions of the two ingredients admit of considerable latitude, but the following has been found to answer well. I dissolve one pound of copper in a gallon of water, and in another gallon of water I dissolve four ounces of white arsenic, and then mix the two solutions, which mixture constitutes my iron liquor. For the purpose of transportation it is desirable to obtain the ingredients from which the solution is to be made, in a dry state; for this purpose I take copperas and drive off its water of crystalization by exposing it to heat upon iron, or in any other convenient mode, and to the dried mass I add four ounces of white arsenic for every pound of copperas first taken, the whole is then reduced to powder, and may be readily converted into iron liquor by adding the proper quantity of water. The tendency of the protoxide, in copperas, is to pass too rapidly and completely into the state of peroxide, by which the object of obtaining a good black color is defeated, an injurious brown tint being produced. The arsenious acid has the property of preventing the peroxidation, and of inducing that state of mixed oxide upon which the perfection of the black is dependant, and this combination of arsenious acid, and its application to the purpose of producing a black color are, as I believe, entirely new. Having thus fully described the nature of my invention, what I claim therein, and desire to secure by letters patent, is the combining of arsenious acid with sulphate of iron, in the manner, and for the purpose, herein fully made known; and this I claim whether the two substances are mixed in a dry state, and afterwards dissolved, or whether the two substances be separately dissolved, and afterwards mixed together. Nor do I intend to limit myself to the proportionate quantities of the two substances herein stated as being generally used, but intend to vary these proportions within any limits which I may find to be advantageous." John D. Prince.

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November, 1840.

December, 1840.

April, 1841.

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OF THE

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OF

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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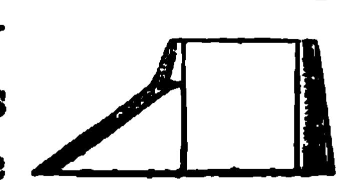
JULY, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the Wooden Aqueduct carrying the Pennsylvania Canal across the river Alleghany, at Pittsburg; from actual measurement. With remarks by JOHN C. TRAUTWINE, *Civil Engineer.*

This aqueduct was built in the year 1829, by Mr. Lothrop of Pittsburg, at an expense to the State of $104,000. It has two abutments, six piers, of stone, and seven arches of timber, of 150 feet clear span each; the whole length of the aqueduct between the abutments being 1092 feet. The masonry is of cut ashlar, in large courses, with rubble filling. The material is a gray sandstone, rather too soft, in my opinion, for such parts of a structure as are exposed to rapid currents, bringing down heavy fields of ice and drift wood, as is the case with the Alleghany. *The piers are seven feet thick on top;* they batter one inch to a foot, on the sides; are semi-circular at their downstream ends; and are provided (at least those of them which are exposed to the principal force of the current,) with *breakwater* starlings, of this shape, up-stream. (This term is frequently applied to such starlings, but I cannot perceive its propriety; the expression savors of tautology.) The average height of the piers is about forty feet.



The timber of the aqueduct is white pine, with the exception of the *chords* and the *pier-posts,* which are of white oak, as being better calculated to resist the great strains that come upon them. I conceive, however, that any precaution of this kind would apply with more

force to the *pole plates*, or cap-pieces, as it is well known that the resistance of timber to compression is much less than that to extension. Therefore, if extra precautions are requisite for the chords, they are doubly so for the poles.

The width of the aqueduct, from out to out of weather boarding, is about thirty-four feet. The height of the trusses, from bottom of chords to top of poles, sixteen feet. The canal trunk has a top width of sixteen feet, a bottom width of fifteen feet, and a depth of five feet. The depth of water is generally four feet; sometimes four feet three inches. There are four trusses to each span. These particulars, however, with the other principal dimensions, are so plainly indicated by the drawings, as to require no further explanation. Throughout the drawings, *the same letters refer to the same parts.*

Table of Scantlings of the Principal Timbers and Irons.

Names of pieces.	References.	Remarks.	Inches.
Arch pieces, . .	L	six to each truss, or composing each rib; each piece	7×14
Pole, or cap, .	J	of inner trusses, ...	10×15
" " " . .	F	of outer trusses, . . .	10×12
Chords, . .	C	of both inner and other trusses, each in two pieces; each piece . .	7×15
Queen posts, . .	Q	in body, ...	9×10
" " .	"	in heads and feet, . .	10×14
Main braces, . .	S	. . . . . .	8×10
Counter braces, .	X	. . . . . .	$8\times4\frac{1}{2}$
Butting pieces, .	P	at heads of queen posts of outer trusses,	5×7
" " .	T	or straining pieces at heads of queen posts of inner trusses, . . .	5×7
Diagonal braces, .	U	in roof, and under canal trunk, .	6×7
Extra braces, .	M	on outer trusses only . .	6×12
Straining sills to ditto,	*k*	. . . . .	6×10
Straining pieces to "	*f*	. . . . . .	6×12
Straining sills to pier posts,	*j*	. . . . .	6×10
Fishing pieces to poles,	*b*	over piers, ...	6×12
Roof girders, . .	E	. . . . .	7×12
Floor girders, .	G & H	. . . . .	9×18
Additional pieces, .	A	under girders marked G only, .	9×15
Plank , .		of footway, towpath, and canal trunk, thickness	3
Weather boarding, .	N	. . . . . "	$\frac{3}{4}$
Iron suspending rods,	R	. . . . .	$1\frac{1}{8}$diam

Screw bolts, 1 inch square; spikes for planking of canal trunk, $\frac{1}{4}$ inch square; spikes at heads and feet of braces, $\frac{3}{4}$ inch square.

In figure 1 it will be seen that the tops of the lower girders are not all in the same horizontal line, but that every other one, H, is raised about one foot above the intermediate ones, G. When the aqueduct was first built, only one of these sets of girders was employed, being supposed sufficient to sustain the weight of water in the trunk. Their distance apart was about ten feet in the clear. But when the water

was let into the trunk, the girders began to yield under a head of about three feet, and it was found necessary to double their number, and moreover to bolt, or rather stirrup, to every alternate one, viz: those marked G, an additional under-girder, A, fig. 2, 3, 4.

The reason for thus alternately raising and depressing these lower girders was, to permit the passage of the two courses of lower diagonal braces from one H to another, over G, (see fig. 9, and also the dotted lines *a*, *a*, *a*, in fig. 3.) Where the H's cross the inner chords, (which are lower than the outer ones,) they are made to bear on them, by means of the blocks *h*, *h*, fig. 3. These blocks are not shown in the transverse section, it being supposed to be taken near one of the girders, G. Over the girders, G, are seen (fig. 3,) blocks O, O, marked in dotted lines; there are transverse timbers, resting on G, and helping to support the flooring plank of the canal trunk, as there are no longitudinal joists in the aqueduct. The pieces O, do not interfere with the diagonal braces, merely running from each inner chord to the braces.

The floor of the trunk rests only on the upper course of diagonal braces, on the transverse pieces, O, and on the raised girders, H.

Each girder, H, and G, is sustained by the two inner chords, and by four suspending rods of iron, one and a half inches in diameter, of which two are shown in fig. 4, by R, R. In the outer trusses, the tops of these rods bear on the tops of the arches, or curved ribs, (see fig. 1,) by means of wooden saddle pieces, D, figs. 3, 4. In the inner trusses, they bear upon the tops of the poles, or caps, and are covered by a longitudinal capping piece, of 3 inches thickness, (*m*, fig. 4:) this capping is rounded off at top, so as to prevent the chafing of the tow-rope.

To bring the bearing of the suspending rods more equally on all the arch-pieces, blocks are inserted between the arch-pieces, vertically, at the place of each rod, as shown in fig. 3. M, M, in fig. 1, are extra braces, employed only in the outer trusses; *k*, *k*, are their straining-sills. At their upper ends they abut against short pieces of 6 $\times$ 12 (*f*, *f*,) firmly bolted to the poles. These extra braces are in pairs, being on both sides of the poles.

j, *j*, fig. 1, are the straining sills for the pier braces, S, S, serving to stiffen the pier posts; see fig. 6, which also shows the cast iron abutment plates, *g*, *g*, for receiving the feet of the curved ribs. They are merely flat plates, three feet eight inches deep, two feet wide, two inches thick, and without any flanches. The recess in the pieces, for receiving the feet of the ribs, and pier posts, is but eight inches deep. See also fig. 2.

P, figs. 3, 4, are the short butting-pieces for relieving the heads of the

queen posts from the action of the main braces. In the inner trusses, instead of these short butting-pieces, long straining-pieces, reaching from one post to another, are used, T, figs. 3, 4. T is represented in fig. 3, to save the trouble of another engraving.

The suspending rods are about five feet apart; but it is seen in fig. 1 that these rods stop short within some fifteen feet of the piers, because the curve of the ribs in that interval would not allow of the passage of girders past them. In this interval, therefore, the ends of the girders are supported by pieces, K, fig. 7, bolted to the ribs.

s, *s*, figs. 2 and 4, are uprights, placed four feet apart, for spiking the side planking of the canal trunk to; at their heads they tenon into a continuous cap-piece, *v*, and at their feet they tenon between the strings *e* and *n*. *n*, and the blocks *t*, being supported by the queens, prevent *s* from spreading outwards.

Where the curve of the arches comes below the line of *t*, the latter is dispensed with, and *v* rests against the arches themselves.

r, *r*, are two pieces, of 3 × 6 inches, spiked to the queens, for receiving the floor plank of the tow-path, on one side, and of the footway for ordinary purposes, on the other.

The roof is boarded and shingled.

Where the tops of the inner arches get below the line of the tow-path floor, a piece of plank, on edge, resting on the floor, is nailed against the queens, to prevent horses from slipping into the canal trunk.

Fig. 5 shows an excellent device for counteracting, to some extent, the tendency which trusses always have to settle in the centre. The poles, or caps of the adjoining arches, are here connected by fishing splices, each composed of two pieces of 4 × 12, well bolted, and tree-nailed together, through the caps; and as a further security, two blocks, *z*, *z*, of hard wood, about four inches square, are driven through, from side to side. By the introduction of these splices, it is obvious that the inward draw of two adjoining trusses is mutually counteracted to a considerable extent. This arrangement, together with the extra braces, serves very much to stiffen the trusses; and something of the kind should always be resorted to in large spans.

Fig. 8 shows the mode of scarfing the pieces composing the curved ribs. These pieces break joint where the ribs pass the queens, so that the bolts of the scarfs pass entirely through the queens, and the rib pieces on each side of them. The scarf of the poles is shown in fig. 3; that of the chords is the same as that of the poles, only that which constitutes the side view of the pole scarf, forms the top, or plan, of that of the chord.

Fig. 11. As it is always a matter of importance in a bridge erect-

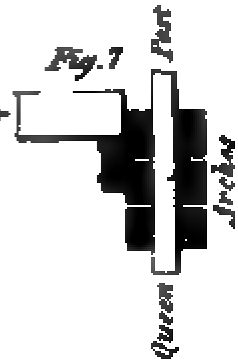


Fig. 7

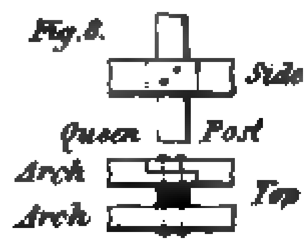


Fig. 8.

hord C
hord I
Fig. 9
hord L
hord C

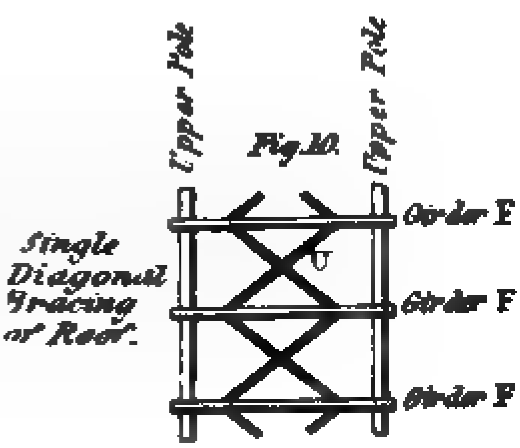


Fig. 10.

Double
Diagonal
Bracing
of Floor.

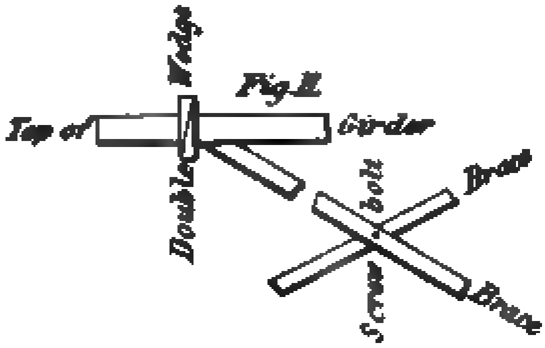


Fig. 11

ed over a stream liable to freshets, to secure each span as soon as possible, so as to stand in case the scaffold should happen to be carried away; the introduction of the secondary timbers is generally deferred until those essential to the support of the bridge, in such an event, are put together. Therefore, the diagonal braces are not inserted until after the girders are put into their places.

As these braces are tenoned into the girders at both ends, they could not be inserted into the mortises in the girders, unless some *play* were allowed at one end; this play is afterwards filled up by a pair of double wedges, as shown in fig. 11.

Where the counterbraces of the trusses intersect the main braces, the former are merely tenoned into the latter, as shown in fig. 3, at Y. Where the chords and queens intersect, they are notched equally into each other, so as to bring the two pieces composing the chords within about an inch of each other, figs. 2 and 4.

The planking of the canal trunk is single, and well caulked. The courses of plank are from six to fifteen inches wide.

Remarks.—This aqueduct evinces, more strikingly than any other structure I know of, the capability of timber for the purpose of bridge building. The weight of water in the canal trunk on a single span, when four feet three inches deep, amounts to 275 tons, of 2240 lbs.; and we may safely say that that weight is frequently increased to at least 300 tons, during the passage of boats; for although a boat, of course, displaces a bulk of water of equal weight with herself, yet it may readily be conceived that the water so displaced does not instantaneously leave the span, on her entrance; and I think we may assume that at least twenty-five tons of it are frequently on a span at the same moment with the boat. Yet on a most critical examination, made with that view, I could not detect in any part of the timbers the slightest symptom of what might with propriety be called *crushing*. Slight *compressions*, (if I may be allowed to draw such a distinction,) were visible at the heads of the queen-posts, but not to a greater extent, apparently, than invariably attends all trusses of this kind in common bridges of large spans, after having been some time in use. In all bridges there is a tendency to settle, or sag, in the centre; and this tendency, of course, brings a heavy compressing strain upon the pole plates; but beside *this* compression, incident to the truss considered *as a whole*, there is *another*, acting at the several points at which the heads of the posts tenon into the poles. This compound compression explains a fact for which I was for some time at a loss to assign a satisfactory reason. I have already stated that in the *inner* trusses of this aqueduct, a straining-piece, like that shown at T, fig. 3, was inserted between the heads of the posts, in

preference to the short butting piece, P, figs. 3, 5, employed in the outer trusses. This was evidently done under the impression that it opposed a more perfect resistance to the compressions alluded to, than the shorter pieces; and, at first sight, it will probably strike most of my readers in the same manner. But it is of great importance to know, that although the long piece is almost invariably introduced, both by engineers and bridge builders, whenever extraordinary compression of the pole is anticipated, it is in fact *entirely ineffective:* whereas the short butting pieces perform the duty assigned them perfectly.

I shall endeavor to point out the cause of this.

The compression of the poles evidently increases from the piers towards the centre of the span, in the same manner as in a single long piece of timber, supported at two ends, when it sags in the middle: consequently, when the bridge settles, as it always will, more or less, the head of any one post is moved a greater distance towards the centre of the span than the post behind it, that is, between it and a pier. Therefore, the opening, p', behind the post, Q', must be a little wider than the opening p, behind the post Q; and, consequently, the inner end of the straining-piece, T, cannot be forced up into contact with the head of the post Q, but must remain distant from it an amount equal to the difference of the compression which takes place in that part of the pole between Q' and the centre of the span, and that part which extends from p' to p. This difference in the amount of compression between any two consecutive posts, is very perceptible in all large bridges, being generally about one-eighth of an inch, that is if there be seven spaces in the truss, between a pier and a king post, the opening at the inner one will generally be about seven-eighths of an inch, at the next one six-eighths, at the next five-eighths, and so on to the queen post near the pier, where it will diminish to nothing. In some bridges, and those excellent ones, I have seen the openings behind the queen posts much greater than this, at least double; but, I believe, only in such bridges as have no chords to confine the feet of the ribs. Of course some portion of these openings, in every case, is due to the compression which takes place in the heads of the posts themselves. This is frequently very perceptible. I could just detect it in a few of the queen posts of the aqueduct.

But it may be objected that if the explanation I have given be correct, then even the short butting piece, P, should also be ineffective; because, if the compression of the pole increases so perceptibly towards the centre, then supposing the length of the butting-piece to be one-fourth of the distance between two queens, the inner end of the butting-piece should not come into contact with the pole, by an

amount equal to one-fourth of the opening which occurs between those two queens. Plausible as this deduction would seem, it is, nevertheless, incorrect, for as I have before remarked, the short butting-pieces act admirably, and, as I conceive, for this reason, that although the entire length of that portion of a pole, or cap, between two adjacent posts, is in a state of compression, which, considering the whole truss as one great beam, gradually increases towards the centre. Still the action of the main braces against the back part of the head of each post, tends to bring an additional strain upon the portion of the pole next adjoining the *inside* of the post head. This additional strain produces a compression of its own, which, unlike that operating on the truss considered as a whole, *decreases* towards the centre. Therefore, that part of the pole into which the head of any post tenons, is more compressed than the part at the end of the butting-piece, and, consequently, the latter is brought into full action.

This matter is a very important one, and my remarks on it were suggested by seeing that in this aqueduct the long straining-piece had superseded the short butting-piece, evidently in expectation of its greater efficiency. In the Market street bridge, at Philadelphia, the finest in existence, the same defect exists; also in the viaduct of the Columbia and Philadelphia Railroad, near Philadelphia, and many others, built by the most talented and experienced bridge builders in the country.

But in all these bridges, as well as in this aqueduct, the inner ends of none of these long straining-pieces are in contact with the heads of the adjoining posts, against which they were intended to exert a powerful compression. Consequently, they are not only useless, but positively injurious, as they add unnecessarily to the weight of the truss, and thus absolutely *increase* that tendency to settle, which they are intended to prevent.

I noticed a splintering, or spalling off, of the stones supporting the feet of some of the arches. The stones in this part of a bridge, as well as those forming the facing of the starlings, should always be of good quality; and, in the former case especially, attention should be paid to their *toughness;* soft sandstone should never be admitted.

In an extreme case like this, of such an immense weight and so soft a stone, or indeed with stone of the best quality, I should certainly prefer to have the recesses in the top of the pier for receiving the feet of the curved ribs and pier posts, somewhat deeper than in this instance, where they are but eight inches deep, figs. 1, 2, and 6. The pressure on the piers and abutments, so long as the bridge maintains itself, is almost altogether vertical, and as it sometimes happens that the bearing is not very fair, every precaution should be used to pre-

vent spalling. One of the spans, at the time I saw the aqueduct, was (in my opinion,) in imminent danger of falling, in consequence of this.

I am confident that two trusses, instead of four, would have been sufficient to support the trunk of this aqueduct, especially if another arch-piece had been added to the depth of the curved ribs, and the height of the trusses made a little greater. This additional height would, moreover, have added to the convenience of passengers on the roofs of the boats, who are now obliged to stoop in passing through the aqueduct. As the use of but two trusses would, of course, increase the clear width between them, to admit the tow-path, the girders might be trussed by a heavy arch-piece, which would insure abundant strength. A considerable diminution of expense would attend such an arrangement.

As to the piers of this aqueduct, they are, as before stated, *but seven feet thick on top*, or $\frac{1}{11.43}$ part of the span; or not quite *one-half as great* as the proportion of those used in the Trenton bridge, which is the boldest one cited by Tredgold, in his table of stone piers for wooden bridges.

I am by no means prepared to advocate the *breakwater* starling, (so called,) used in this aqueduct, and in many large bridges in the country. I have known them to pitch very heavy blocks of ice upon the roof, and outside footways of the bridges to which they were attached. This never occurs with semi-circular starlings, and as I have never known one of the latter shape to be injured when built with care, I consider it preferable to the other—though I think something like a semi-ellipse still better. My own practice is to batter the fronts of the starlings two inches to a foot, and work them into one inch to a foot, as they approach the sides of the piers. Experience has given me every reason to be satisfied with this shape. In very exposed situations, there would be no objection to increasing the front batter to considerably more than two inches to a foot.

The foundations of the piers of the aqueduct do not appear to have settled in the least, or to have undergone any derangement; still, even in the face of this precedent, I should certainly prefer the foundation to be laid at the depth of a few feet below the bottom, in structures so important as this. There are, however, several bridges across the Alleghany, in the vicinity of the aqueduct, and all their piers are founded in this manner, (some of them, indeed, having but one course of timbers in their platforms,) which is strong evidence of the sufficiency of the plan, on a gravel bottom, even when exposed to tremendous freshets.

Viewed as a whole, this aqueduct, for which, I am under the impression, there was no precedent, certainly reflects the highest credit

on Mr. Lothrop, for boldness and mechanical skill.* There are others, of much the same kind, on the canal; all, I believe, designed by him. The general arrangement of the timbers is not original with him, having been long before practised, in very many instances, in common bridges; but the application of it to the purposes of so extensive an aqueduct, was certainly a very bold step; and its entire success is proof of an intimate knowledge of what he undertook.

I look upon this arrangement of timbers as the best yet devised for large spans. It certainly admits of many improvements in its details, and from some experiments of my own on the subject, I am under the impression that considerable modifications in some of the more important parts, might be made with advantage. I may take occasion, in some future paper, to allude to them.

The curved rib, it is well known, *is stronger* in the centre than at any other point; or, in other words, a load, which, applied between the centre and one of the piers, would destroy the rib, might be supported, with perfect safety, in its centre. But the truss which is connected with the ribs, *is weaker* in the centre than at any other point; its resistance to a load acting at any point, being, as in the case of a single piece of timber, proportional to the rectangle of the distances from the point at which the load is applied to the points of support. *Therefore, the combination of the curved rib with the truss, secures a more uniform degree of strength throughout the whole span, than could be attained by either one, used separately.*

But besides this, another very important consideration attends the combination of the curved rib with the truss, viz.: that each not only contributes its own share to the support of the load, but actually *increases the power of resistance of the other*—that is, the two combined will support a greater load than they could separately, were the load divided between them. A curved rib, when employed by itself, is very weak at the haunches, and readily yields to a load applied there; but if proper means be adopted for preventing the rib from *changing its form*, its strength is wonderfully increased, indeed to such an extent that actual crushing of the timber must take place before the rib will yield to its load. Without this precaution, its flex-

* We think it proper to remark here, that in the sixth volume of the London Repertory of Arts, p. 220, is detailed at length, the specification of a patent taken out in England, in 1796, by Mr. James Jordan, *for constructing aqueducts and bridges, with curved ribs of timber, or iron, and suspending therefrom, by iron rods, the floor or trunk, as the case may be.* The celebrated bridge over the Delaware, at Trenton, commenced in 1804, is, in its general outline, almost a precise copy of the plate illustrating Jordan's patent, in the Repertory of Arts, and is, in principle, unquestionably, *an infringement of that patent.* Mr. Jordan also gives a plate of a projected aqueduct, precisely the same in its essential principles as that which forms the subject of the above paper. Com. Pub.

ibility will permit it to bend, and fall through between its abutments, under a load many times less than that necessary to *crush* it. *Such a change of form, or bending, is prevented by the truss,* and thereby so great an accession of strength is imparted to the rib, that if we could conceive of the truss acting only in this capacity of a stiffener to the rib, without itself sustaining any portion of the load, still the strength of the bridge would be increased many fold. I have seen curved ribs of 200 feet span, bend, and fall into the river, between their abutments.

The highest known freshet of the Alleghany, rose to about the floor line of the canal trunk; the weather boarding of the outside formed a kind of dam, against which, trees, barns, houses, &c., accumulated, until they formed a wide field of drift on its upper side. A large concourse of people stood on the banks of the river, expecting to see the whole structure lifted off from its piers, and floated away; but it stood perfectly firm, and I believe sustained no injury whatever.

It is my intention to endeavor, through the medium of the Journal, to supply, in some measure, a deficiency that exists in all our works on carpentry, in that department which treats of the spanning of large openings. The best mode of doing this will, probably, be to present to the reader a series of papers, descriptive of existing structures, with such comments as may happen at the time of writing, to be suggested by the particular example under consideration. This paper may be looked upon as the first of the series, and I shall endeavor to follow it up, as my leisure permits, by other interesting examples of such works as have come under my own immediate notice. In some future paper I shall enlarge more fully upon the several individual timbers composing such a truss as that employed in this aqueduct. The subject of wooden bridges, of large spans, is a very interesting and important one, and one of considerable intricacy. Its importance has of late been much enhanced, by the discoveries of preservatives of timber from decay. Should an equally effective preservative against fire be discovered, which, under the present rapidly increasing discoveries in chemistry, is not at all improbable, we should have much less reason than at present to regret our national want of fine stone bridges.

Athens, Tennessee, May, 1842.

Mode of Tracing a Curve of very large Radius, adopted in the Survey of the Northern Boundary of the State of Delaware, in 1701.

Professor JOHN F. FRAZER has deposited at the Hall of the Franklin Institute, in Philadelphia, some interesting documents, concerning the original demarcation of the curvilinear boundary, dividing the northern part of the State of Delaware from the conterminous States of Pennsylvania and Maryland. These documents consist,

I. Of the original warrant by William Penn as "Proprietary and Governor of Pennsylvania and the counties annexed;" bearing date the 28th day of the 8th month, 1701, and directed to Isaac Taylor, of the county of Chester, in the province of Pennsylvania, and Thomas Pierson, of the county of Newcastle, "*in the territories;*" instructing them to accompany the magistrates of each county, or any three of them, within the space of forty days after date, and in their presence to admeasure, and survey, a circular boundary line, struck by *a radius of twelve miles*, from the town of New Castle, as a centre; the line to be well marked, and to consist of "*two-thirds of a semi-circle of twelve miles radius.*"

II. Of a duplicate record of the official proceedings of the appointed surveyors, and the field notes of the survey, made pursuant to the aforesaid warrant, in the presence of six magistrates—three of the province of Pennsylvania, and three of the "*annexed territories,*" now the state of Delaware.

By this document it appears that the centre of the arc of the circle, or the point of beginning the radial line, was established by the magistrates "at the end of the horse dike next to the town of New Castle," thence by various courses, *rectified to a due north line*, the surveyors ran off *the radius of twelve miles*, terminating at a white oak tree, in a sinuosity of the Brandywine Creek; and as it will probably be more interesting, we subjoin an extract from the official memoir, in which the surveyors (in their own language,) give a brief account of their operations, in first tracing a radius of twelve miles, *due north*, and then marking out the required segment of 120°, by uniform angles of deflection from primary chords, *as is at this day practised* upon railroads, and similar works.

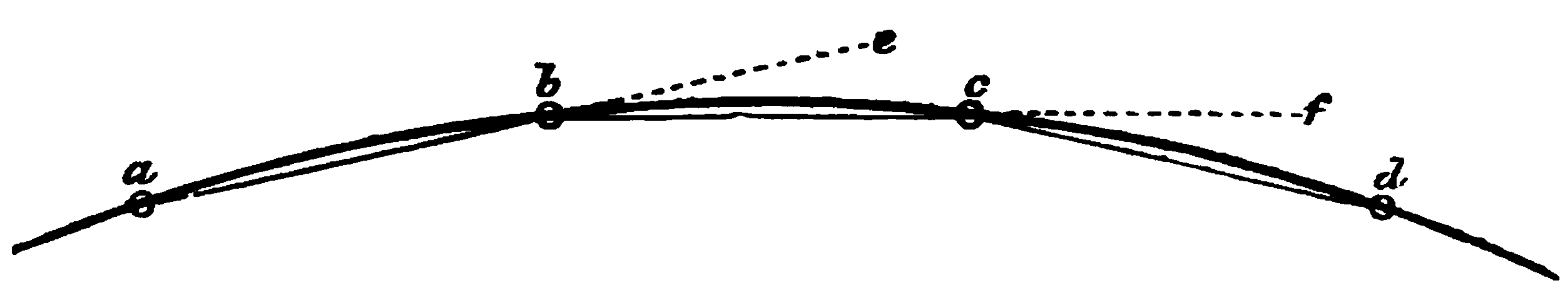
Extract from the Surveyor's Memoir.

"The 26th day of the 9th month we did begin, in the presence of the said justices (Cornelius Empson, Richard Halliwell, John Richardson, Caleb Pusey, Philip Roman, and Robert Pyle, Esquires,) at the end of the horse dike, and measured due north twelve miles, to a white oak, marked with twelve notches, standing on the west side of

Brandywine Creek, in the land of Samuel Helm; and from the said white oak we ran eastward, circularly, changing our course from the east southward, one degree at the end of every sixty-seven perches, *which is the chord of one degree to a twelve miles radius;* and at the end of forty-three chords we came to the Delaware river, on the upper side of Nathaniel Sampley's old house, at Chichester; and then we returned to the said white oak in Israel Helm's land, and from thence we ran westward, changing our course one degree from the west southward, at the end of every sixty-seven perches, as before, until we had extended seventy-seven chords, (which being added to the forty-three chords, make two-third parts of the semi-circle to a twelve mile radius,) all which said circular line being well marked with three notches on each side of the trees, to a marked hickory, standing near the western branch of Christiana Creek. Surveyed the 4th day of the 10th month, 1701, by us."

(Signed) Isaac Taylor,
Thos. Pierson.

To elucidate more fully the principles involved in this demarcation, we subjoin a diagram (on a scale necessarily distorted,) showing three of the chords assumed at random from the eastern part of the survey.



Uniform length of each chord = nat. sin. $\frac{1}{2}° \times 12$ miles, rad. $\times 2$ or $.008726 \times 3840$ perches $\times 2 = 67.01952$ perches, *say* 67 *pers.*, which is the chord of 1° of a circular arc, of the radius fixed; as is correctly stated in the surveyors' memoir.

$$\text{Chords,}\ \left\{\begin{array}{l} a\,b = \text{S. } 79° \text{ E. } 67 \text{ pers.} \\ b\,c = \text{S. } 78° \text{ E. do.} \\ c\,d = \text{S. } 77° \text{ E. do.} \end{array}\right\}\ \begin{array}{c} \text{Angles of deflection,} \\ e\,b\,c,\ f\,c\,d, \text{ \&c.} \\ \text{uniformly } 1°. \end{array}$$

The surveyors began their field labors on the 26th day of the 9th month, 1701, and closed them on the 4th day of the 10th month, having occupied but nine days in the work; running, within that time, twelve miles of radius, and twenty-five and one-eighth miles of chords of the curve—in all upwards of thirty-seven miles, or more than four miles surveyed and measured each day, at an average.

When we consider the care required in tracing the chords by rectified courses, and the obstacles which the face of the country must then have presented, *this was rapid work;* and it stands forth in striking contrast to the vast length of time, which similar geodesic operations are at this day made to consume.

It will be obvious to all who are conversant with matters of this nature, that the mode adopted in 1701, by these surveyors, *in tracing this arc of twenty-five miles long,* upon a radius of twelve miles, *is in substance the same* as that so generally used at the present time in marking out upon the ground the large circular curves of railroads, in which—as in the case of this boundary line—the centres are at an inconvenient distance.

The main principle involved is, *that of deflecting a constant angle in passing from one chord to another of equal length;* by which process a number of points in a circular arc may be correctly established, by the salient angles of the inscribed polygon, as is easily shown from the geometry of curves.

In railroad surveys the primary chord is usually assumed at the fixed length of one hundred feet for all curves, (instead of sixty-seven perches, as adopted in this case, to make the uniform angle of deflection 1°;) and the angle of deflection between the chords is, for any given curve, made proportional to its radius, as must necessarily be the case when the chord employed is of a constant length: still the principle involved, as well as the mode of operating with the circumferentor, is precisely the same in marking out a railway curve, as was employed by Messrs. Taylor and Pierson, in the trace of the circular boundary line above described, and which is highly creditable to them, as a practical operation, performed with the most simple instruments.

The idea has been generally entertained that Lieut. Col. Long, of the United States Corps of Engineers, was amongst the first to deduce from the geometry of curves, and to apply, practically, the mode of tracing circular arcs of large radius, to which we have just referred; and in a little work published in Baltimore, in 1829, entitled the *Railroad Manual,* which has become amongst engineers a text book of curvature; Col. Long developed in a very perspicuous manner, all the principles necessary to the demarcation of great curves, by means of primary chords of one hundred feet; as well as to enable the inscription within the primary arcs, of a decimal system of sub-chords; but from what we have said above, it would appear that in the main features of the process he had been anticipated, as long ago as the year 1701, by Messrs. Taylor and Pierson, the surveyors of the circular boundary line of Delaware.

Before closing this subject, we must remark that, although the boundary surveyors clearly developed the plan of tracing a large arc of a circle, *by constant angles of deflection between primary chords of equal length,* so as to be geometrically correct; nevertheless it is singular that, in applying these principles upon the ground, they have

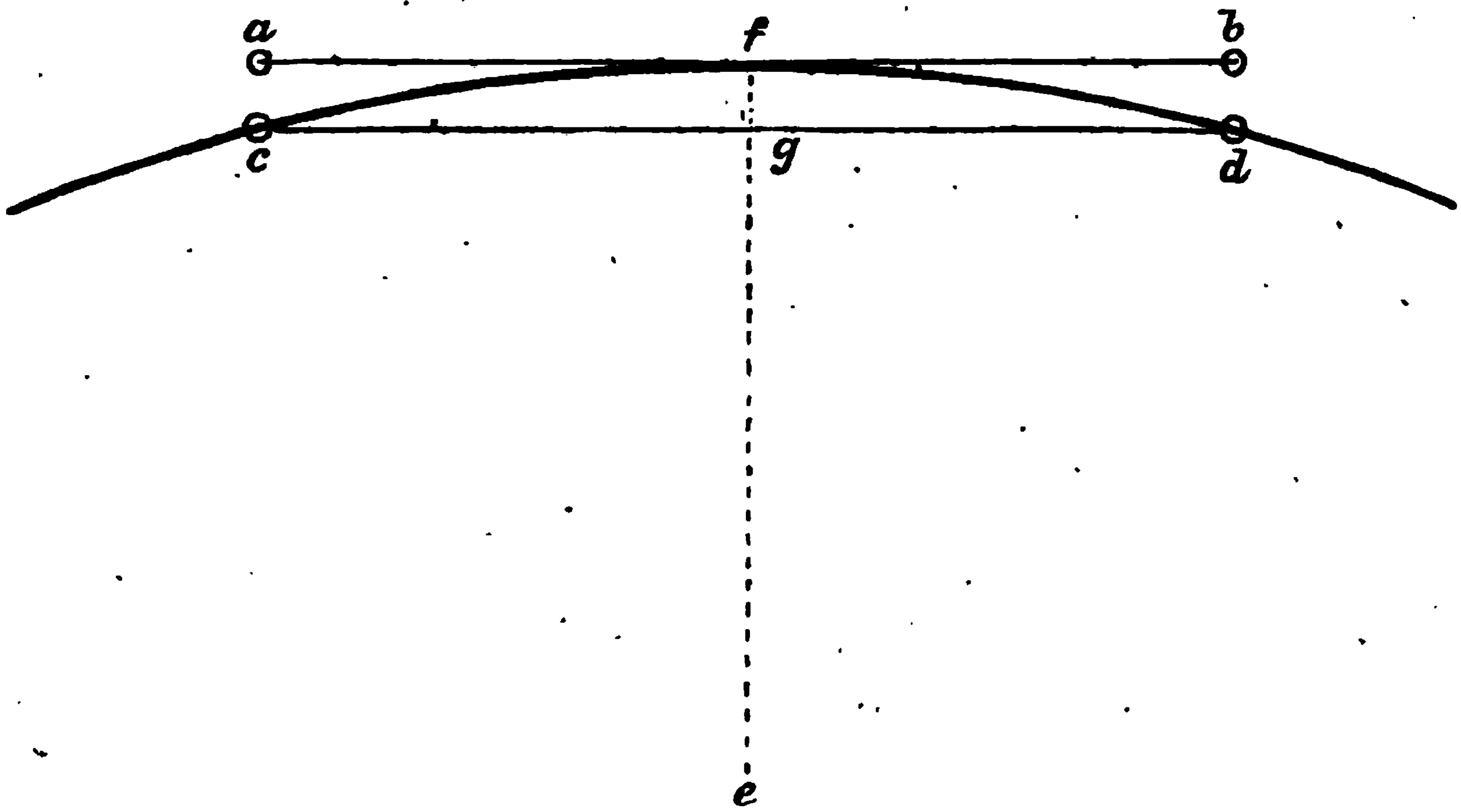
committed an error, in consequence of having laid the line intended for the first chord, *in the position of a tangent to the arc.* It appears from the field notes, that after having run off north from the town of New Castle a meridian line, as radius, the surveyors determined that the first chord of their circular arc should bear east and west, and, therefore, be *bisected* by the meridian radius; now it is perfectly evident that any chord of a circular arc, *bisected by a radius,* must cut that radius at a distance back from its extremity, equal to the versed sine corresponding to the given chord; therefore, in the case before us, the surveyors ought to have set back towards New Castle, from the extremity of the meridian radius of twelve miles, the proper length of the versed sine, or, nat. vers. sin. $\frac{1}{2}^{\circ} \times 12$ miles radius $= .0000381 \times 3840$ perches $= .1463040$ perches, or 2.414 feet; and from the correct point of concourse of the radius and chord determined thus, they should then have laid off from the meridian the courses and distances recorded in their field notes, viz: East 33½ perches, and West 33½ perches—in all 67 perches, the calculated length of the chord. This process would have correctly fixed the position of the chord, and, from its eastern and western extremities, the courses and distances of the field notes being run off, *an inscribed polygon* would have been correctly formed about "the end of the horse dike" at New Castle, as a centre.

But from the field notes it would appear that the right line designed for the first chord of sixty-seven perches, was laid off equally east and west, *from the extremity of the meridian radius;* it therefore occupies a false position, as regards a segment of a circle of twelve miles radius, described "*from the end of the horse dike*"—in fact, it is tangent to such an arc—but, nevertheless, in connexion with each other, the whole 120 chords run by the surveyors, do actually form sides of a polygon inscribed within a circle of twelve miles radius, *but relating to a centre, distant from the intended one, due north, the length of the versed sine, corresponding to the chord of one degree of the arc.* In consequence of the great length of the radius, this distance is fortunately of but little practical importance, being but 2.414 feet, as we have shown above; so that the real centre of the circular boundary line actually traced, is nearly two and a half feet distant from that which was established by the assembled magistrates.

The annexed diagram (on a scale distorted, of course,) will convey more clearly to the eye, the error we have attempted to point out.

a, b,= The east and west line, of sixty-seven perches, traced by the surveyors, in lieu of the proper chord, *c, d.*

e, f,= A portion of the meridian radius of twelve miles, run due north from "*the end of the horse dike.*"



f, g, = The versed sine corresponding to a chord subtending one degree of such an arc = 2.414 feet, which is of course the distance *due north,* which the centre of the circular segment was *in effect* removed by the error which appears to have been committed by the surveyors. M.

Facts and Observations on Four and Six Wheel Engines. *
By John Herapath, Esq.

[continued from vol. iii, page 391.]

Midland Counties Railway.

This line, as the public knows, unites Nottingham with Derby, and both with the London and Birmingham at Rugby. The length between Derby and Nottingham is 15½ miles; between Derby and Rugby 49½ miles; and between Nottingham and Rugby 47¾ miles. The total length of line worked is 57½ miles.

Here I have had an opportunity of seeing stone blocks, cross sleepers, and longitudinal bearings, mixed and intermixed in such a manner as to make a strong and decisive impression upon me of their relative advantages, of which I shall speak hereafter.

* The subject matter of these interesting papers—which we are engaged in re-publishing from the Railway Magazine—acquires renewed interest, from the occurrence of the late shocking accident upon the Paris and Versailles Railway, in France.

In this fearful catastrophe, it appears, from the newspaper accounts, that the passenger train was drawn by two engines, as in the case of the accident on the London and Brighton Railway, which we noticed at page 243 of the last volume; and, *as in that instance,* the auxiliary, or leading, engine, was *a four wheeled machine,* whilst the other ran on *six wheels.*

So also in the former, as in the latter case, *the four wheeled engine* was the first to fly the track; the second followed, and the destruction of carriages, and consequent loss of life, was terribly aggravated, by the fact that *at the same time* the train was also *impelled forward* from behind, by *a third engine,* attached for that purpose, which, partaking of the high velocity of the whole train, the moment the stoppage took place in front, drove forward, over the ruins of the rest, some of the rearward cars, which might otherwise have been saved with their passengers, and probably without injury. Com. Pub.

The great blot upon this line is a curve of only 11 chains radius, crossing the Derwent, and entering the station at Derby. Being at a terminus, it can be productive of no danger, but in the perpetual strain which it impresses on the engines while traversing it, and the play which they are obliged to have upon the rails and axles to compass it, are, in my opinion, great sources of expense in the wear and tear of the engines, and, also, upon all the rest of the road; for wherever great play is upon the rails, and in the axles, a strong sinuous motion is the consequence, and, naturally, an excess of wear and tear, both of the engines and road.

The Midland Counties' Company's stock consists of 29 passenger, and 6 merchandize, engines—28 of the former having four wheels and inside bearings, and one four wheel with outside bearings, and cylinders outside these bearings. Of the merchandize engines, four have four wheels and inside bearings, one outside bearings and six wheels, and one with outside bearings, outside cylinders, and six wheels. The four wheel passenger engines weigh from 11 to 12¼ tons each; the four wheel merchandize, 12 tons 6 cwt.; and the six wheel, nearly 15 tons. The proportion of weight on the leading and driving wheels of the lighter passenger engines, is as 3½ to 5¼, and on the heavier, as 4 to 5¾; on the merchandize, as 4 to 5½. Four of these four wheel engines are coupled, and they are described as working pleasantly, safely, and economically. One of six wheel has flanches, "and is done without."

Of these 35 engines, 29 are now (December) ready to take a train.

But very few detentions of trains are represented to have taken place, and these not from derangement of machinery, but now and then cases have occurred of detentions from the bursting of boiler-tubes. There have been no failures from broken crank axles, and only in one case has an engine run off the line, and that was from the embankment having subsided a foot during the night, and a dense fog having in the morning prevented the engine driver of the first train from seeing the state of the road. This was with a four wheel uncoupled engine.

The first cost of engines of this company is from £1,250 to £1,400.

In answer to the question of what his experience tells him is the advantage of four or six wheel engines, one over the other, Mr. Kearsley replies, "both have advantages under different circumstances." I could have wished he had been more explicit, as from his experience with both kinds, his opinions merit attention. This gentleman says they have no top-heavy engines, and very little motion in any of them, except a little sinuous, owing to the play which they feel it necessary to give the leading wheels in the axles to combat the curves with. These sinuous motions, he observes, are nearly the same in all parts of the line, the Derby curve, I presume, excepted.

The average consumption of coke is from 25 lbs. to 35 lbs. per mile for passenger trains, and from 40 lbs. to 50 lbs. for merchandize trains. From some oversight, I suppose, he has not given me the gross loads taken with either train.

I believe, not one of their engines works expansively.

Mr. Kearsley is of opinion, that the nearer the cranks are to the principal axis of the engine, the steadier the engine works. The current locomotive expense of repairs, per mile, according to the last two months' returns, is 13½d.

On Wednesday and Thursday, Dec. 8th and 9th, I had opportunities of riding on seven of this company's engines—the *Vulture, Lynx, Sultan, Centaur, Bee, Hercules,* and *Unicorn;* all of which, except the *Hercules,* were four wheel engines.

The principal motions I observed in these engines were the sinuous, and these were obviously owing to the great play the engines had to prevent too great strain in turning the curve at Derby. The *Vulture* was an extremely lively engine, but too short in the springs, which made her rough to ride on. The *Lynx* was an easier engine to the rider. The *Sultan* was evidently a strong and powerful engine, but inferior in steadiness to the *Centaur.* The *Bee,* the engine to which Hall's smoke-consuming apparatus is applied, is a little four wheel engine, only five feet distance between the axles, with outside framing, and cylinders outside the framing. By some means she has a sad character for endeavoring to turn her tail where her head ought to be, while running on the rails. However, in spite of this character, I accepted the offer of a ride upon her from Nottingham to Derby. There was a strong wind on our right, and we came along at a rapid rate for a little engine like the *Bee;* I should think, at some times, full 45 miles an hour. With such a wind and speed, and nothing but a slender rail to hold by, I had some difficulty, in the most exposed situation on the engine, to keep my place, and certainly had no small portion of my attention directed to the means of preventing myself from being blown off. However, from the attention I could spare, I did not perceive any of that dangerous tail-turning which I had heard of, nor any of that lateral wriggle I had noticed with outside cylinders, both on the Birmingham and Gloucester, and North Union, Railways. She had much sinuous motion, but appeared to me to have no other of any consequence, and so I told Mr. Kearsley when I arrived at Derby. Indeed, I thought I had here found an exception to the rule I had observed with all those engines having outside cylinders which I had rode on, namely, a lateral, or side, wriggle, or vibration, keeping time with the beats of the piston. In a letter, however, which I have since received from Mr. Kearsley, he mentions a subsequent trial with her, undertaken at my request, that considerably shakes my opinion. As he intends another trial, I forbear to say more of it at present.

The last engine, the *Bee,* and another, the *Hercules,* a six wheel engine, with outside framing and outside cylinders, and driving-wheels in the middle, were very kindly put on to special trains of goods by Mr. Kearsley, in consequence of the publication of my disappointment on the Grand Junction line with the *Œolus,* and such valuable opportunities they afforded, that I felt thankful to the parties of the Grand Junction for the disappointment.

Upon the *Hercules* I rode from Derby to Leicester, and though, probably, she was a good engine, both Mr. Kearsley and myself could not help noticing her sluggish heavy movements in comparison with

the nimble and agile motions of the previous four wheel engines. The contrast to me appeared very much like that of a heavy cart-horse to a blood-horse, and the same has been always my experience. Somehow or other, the four wheel engines trip off with their loads as if to take them was no effort, while the six wheel labour like animals over-encumbered with their own weight.

The *Hercules* had very sensible longitudinal motion when the velocity approached 25 or 30 miles an hour, and a considerable degree of lateral wriggle, which by leaning against the side rails and watching the eccentrics, Mr. Kearsley and myself observed kept time as nearly as we could determine, with the beats of the pistons.

While traveling upon this engine, I walked several times along the platform by her side, to her very front, stopping at various points to observe her motions. On the platform by her fire box, her side wriggle, and other motions, were most sensible; over the driving wheels they were much less so, and over the leading wheels, near where the cylinders were, they were to me imperceptible. The sinuous motion of her front framing, which on the platform appeared very great, when I stood at her head was very insignificant.

From Leicester I rode to Rugby, on the *Unicorn*, a very favorite engine, and deservedly so, of the Secretary, Mr. Bell. She was about the best engine of the company I had been on, most lively and active, but very noisy, from the constant blowing off of steam, which it seemed she generated without limit, as move at whatever rate we chose, she had still a superabundance of it. This engine was not without longitudinal motion, and, I thought, a slight disposition to roll.

The following table of these engines was furnished by Mr. Kearsley.

Particulars of Locomotive Engines inspected by Mr. Herapath.

For the following synopsis, extracted from a letter to me, of Dec. 14, I am indebted to the same gentleman.

"I send you a rough sketch of our line, with the distances, by which you will see we have three independent lines to work, viz:

from Derby to Rugby, 49½ miles; from Derby to Nottingham, 15½ miles; and from Nottingham to the Junction, 7½ miles; which makes it a very difficult line to work, more especially as we have the London and Birmingham at one end, and North Midland and Derby and Birmingham, at the other; and we have to time our trains to suit all three.

"We run about 1,200 miles per day with trains and merchandize, and 500 miles on Sundays. The engines run commonly six weeks, and then stay in a week, except in cases where men have two engines appropriated to them, and, if both are in repair, they run every alternate week—every day in the week 100 miles, and take their turns on Sundays—this is between Derby and Rugby.

"Between Nottingham and Derby, two engines do the work; one runs 93 miles every day, and the other 60 miles every day. They change every week from the longer to the shorter distance.

"One engine in the day does the work between Nottingham and the Junction, running five trips there and back, or 75 miles per day. The driver there has two engines, and runs them alternate days, as the short length and frequent turning I think worse for an engine than running fifty or sixty miles in a length.

"Our goods engines between Derby and Rugby run three days and stay in one, then run three more days, and then in a day, and so on. Two engines came into the hospital yesterday, one having run 30,000 miles, and the other 25,000. Both have come in for new fire-boxes, the original iron boxes having failed, and I am about to substitute copper ones. Had it not been for the failure of the iron fire-boxes, I don't hesitate to say, that the machinery would have run as far again, with trifling repairs occasionally.

"Our bulk of expense in repairs has hitherto been in fire-boxes, nearly all the engines having been originally made with iron boxes, and the deceitfulness, if I may so term it, of that material, has added, I may say, at least 25 per cent. to our repairs. And I expect this will be proved, as I gradually substitute copper fire-boxes."

On this railway I had an opportunity of making some observations, which it may not be amiss here to record. In our travels from Nottingham to Leicester, on Wednesday morning, there having been previously a little rain, I was struck with observing the rails which lay on cross sleepers hold their wet and dampness much longer where the ballast came up to them and was within two or three inches of the top of the edge of the rail; and to part with it much earlier when the ground was hollowed out, and clear of them, to drain the surface. This was not universal, but it was so very general for nearly the whole distance, as obviously to make it, where it was not, the exception to the rule. What may have been the cause, unless it being a mild morning the ballast was much colder than the atmosphere, and communicating that cold to the iron in contact with it, prevented the quick evaporation of the wet, I am unable to explain. Mr. Kearsley, whose attention I called to the phenomenon, at first thought it might be owing to the air having a freer circulation round the rail where the ground was hollowed out, which caused a quicker

evaporation; but I was not satisfied with this explanation, and I do not think he was at last, inasmuch as there was little or no current of air, and the appearance was observed in nearly all situations.

The next day we had an opportunity of traveling over stone blocks, cross sleepers, and longitudinal bearings, the two latter in an instructive variety near Rugby. The unpleasant rigidity and harshness over the stone blocks were very sensible, but our attention was chiefly drawn to the comparison of cross sleepers with longitudinal bearings. I had previously mentioned some experience on the Hull and Selby Railway (which I shall hereafter detail,) of the greater draught over longitudinal bearings than over cross sleepers, with which he said his observations agreed, and now we endeavored to appreciate the comparative effects of the two as we traveled along. It appeared to me, and I believe to him, that the train ran much heavier on the longitudinals, which, like traveling over a heavy road, one easily feels; and between the sounds over the two there was no comparison. Over the cross-sleepers the train ran with comparative silence, but over the longitudinals there was a constant heavy murmur and noise. These phenomena of draft and noise happened not in one place, or change, only, but in every one—of which we had a much greater variety than I could have expected to meet with on any line. *To me the observations on this line are satisfactory in favor of cross-sleepers, as to lightness of draught and absence of noise.*

Birmingham and Gloucester Railway.

The American Engines.—I have recorded my experience of these engines, which is, that I was much pleased with their motions at velocities under 20 miles an hour. Since my return from the Great Western Railway, I have received a letter from Captain W. S. Moorsom, the engineer of the line, in which it appears that his experience of these engines, so long ago as the early part of 1840, as nearly as possible coincided with what I have said, page 1074 in the last volume of the *Railway Magazine.* * The following is an extract from his certificate, given the 16th of January, 1840:

"The general result in my mind is a conviction that Mr. Norris's engines are admirable machines, particularly for full loads, say 100 tons, at a moderate speed, say 20 miles per hour; and for such occasions I should prefer them to any English engines with which I am acquainted. I have not yet had sufficient experience to judge of their durability, but I should infer from what I have seen, that in this respect, also, they will prove full as durable, and as economical, as any that we have in this country."

With their performances, as to motion under 20 miles an hour, I quite agree with Captain Moorsom. I had no opportunity of witnessing their power, but according to a private document which I have received, detailing some experiments and comparisons of them with one of our best English maker's engines, they fully merit all that the gallant Captain has said of them.

[TO BE CONTINUED.]

* Jour. Frank. Inst., vol. iii, 3rd series, page 385.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Earle's Process for Preserving Timber.

To the Committee on Publication.

Gentlemen:—In the Journal for last April, page 243, there is, appended to the communication of Mr. Trautwine, a note, which throws doubts on the efficacy and value of the process for the preservation of timber by the sulphates of iron and copper; and "these doubts are chiefly founded upon two facts.

"1. The wooden pavement in this city, in Sixth street, between Chesnut and George—a part of which was prepared by Earle's process prior to being laid—*now exhibits symptoms of decay.*

"2. The recent admirable experiments of M. Boucherie, upon the means of preserving timber, show that whilst corrosive sublimate and pyrolignite of iron effectually protected vegetable pulps from decay, the sulphates of copper and iron (employed by Dr. Earle) were so inert as to retard corruption in but a very trifling degree."

Such is the "note,"—which I have copied at length, that it and the remarks I desire to make on it, may accompany each other.

That there are in "the part prepared by Earle's process" (of the pavement in Sixth street,) as many as six or eight (or, not to diminish the number, say a dozen,) blocks which "*now exhibit symptoms of decay,*" is a fact not to be questioned; but those blocks are *single, insulated,* and in no instance, that I can discover, have had *any effect on the integrity of the adjoining blocks*—which, thus far at least, may be considered as of too sound constitution to be infected, or as *non-susceptible.* This is strong confirmation of the opinions expressed by Mr. Wallace and Mr. Thorn, in their (subjoined) certificate, that these imperfect blocks were *originally defective.* The opinion is still more powerfully strengthened by the condition of the remainder of the pavement in Sixth street, which is rotten and rotting from one end to the other—the decay having extended from the first block that gave way to the surrounding blocks—is already in extensive holes, constituting a large proportion of the pavement—the whole of which requires to be renewed. The same, or rather worse, is the condition of the square in Chesnut street, immediately contiguous, from Sixth to Fifth streets. Now, be it noted, that the whole of these pavements (in Sixth and Chesnut streets) were laid (in the summer of 1839) of precisely the *same wood,* and at the *same time.* Chesnut street required repairs in fifteen months after it was laid, has been often repaired since, and is now about to be renewed.

These are facts which lie exposed to the view and investigation of

any one interested in them, and are intimately—necessarily—connected with the *inference* to be derived from the admonitory "note," and importantly affecting it.

The quality of the wood, originally, was the *worst.* Of old hemlock, it had, part, if not the whole, been piled some time on the Market Street Railroad, and subsequently on the City Lot, where it was long exposed to all the influences of change of seasons and weather. I had, during a month or two, refused to accept it as the material for the first public essay of my process; but, finding that better was resolutely denied me, and confident in the *principle* of the process, I committed its reputation to this wood, hoping that some subsequent more propitious employment of it might soon occur. The result has been favorable beyond what it was reasonable to hope. That "part" of the pavement has, with the above individual exceptions, maintained its soundness, and already has outgone the anticipations justified by the quality of the wood. How much longer it will last, remains to be seen; but a comparison of it with the adjoining pavements, of the *same wood,* laid at the *same time,* is a demonstration of all I could desire of the process, and suggests the question—if such is its effect on this wood, how much greater may it not reasonably be expected to produce on wood of good quality? The certificate of Mr. Wallace and Mr. Thorn, will give confirmation to what I have stated.

"To correct an erroneous and injurious impression, entertained by many, relative to the wooden pavement in Sixth street, between Chesnut and George streets, we certify, that only a part of it was prepared according to Dr. Earle's process with the sulphates of iron and copper—the remainder being prepared with lime; that the former is still perfectly sound, except six or eight blocks, which, from examination, appear to have been originally defective, (the entire wood of that pavement is of hemlock that had been long kept and was very much injured in its quality;) and that the remainder of it, (prepared with lime,) up to the line where the former ceases, is so far decayed that at this time it almost requires renewal. The contrast between the two portions of that pavement is, in short, of the most obvious and conclusive kind.

T. K. Wallace, *City Commissioner.*
Enoch Thorn, *City Carpenter.*

Philadelphia, April 25, 1842."

To M. Boucherie's "admirable experiments," I will oppose but one of the many facts that might be arrayed against them. It is, at least, as authentic, and by most minds, I believe, will be received as infinitely more conclusive. It is an extract of a letter from James Archbald, Esq., chief engineer of the Delaware and Hudson Canal and Railroad Company; dated "Carbondale, March 21, 1842."

"To your inquiries as to the long continued trial I have been making, of the rope prepared according to your process, with the sul-

phates of iron and copper, since your reference to it in your circular of March, 1841, I have the gratification to state, that at the request of John Wurts, Esq., the President of the Delaware and Hudson Canal and Railroad Company, that piece of rope (it was such as is known as two inch rope,) was subjected, about two years ago, to the most powerful influence of heat and moisture I could produce, by means of a hot-bed, or fungus-pit. Along side of it was placed another piece of similar rope, not so prepared, which, when I opened the pit to ascertain the result, was found entirely rotten. I then replaced it with a *second* sound piece, laying it, as before, by the side of yours; and in due time, was found thoroughly decayed—and in the same way, a *third* piece was completely destroyed. Indeed, so severe was the test, and the preservation of the rope, at the end of the experiment, was so satisfactory, that it induced me to recommend your process to the Company, whose mines and railroad are under my charge, and who are in the use of large amounts, both of timber and rope, for the inclined planes. I am glad to find they have adopted my advice, and contracted with you."

I have thus endeavored to separate and rescue the "part which was prepared by Earle's process," and the process along with it, from the condemnation, or doubt, likely to be cast on them by the "note," and I will not scruple to say, that a consideration of the quality of the wood—the present actual state of this "part,"—and of the extent and character of the decay it exhibits—with a comparison of it and the adjoining pavements of the *same wood,* laid at the *same time,* —furnish a conclusion altogether corroborative of the preservative power of the process, and satisfactory to my utmost wishes.

In less space, and with less particularity, I could not have given what I consider as their true and proper position and aspect to facts, of which the "note" itself indicates the importance.

I am, respectfully, gentlemen,
Your obedient servant,
EDWARD EARLE.

Philadelphia, June 8th, 1842.

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. DUMAS.

Life, whose painful mysteries you are called upon to fathom, exhibits among its phenomena some which are manifestly connected with the forces that inanimate nature herself brings into action, others which emanate from a more elevated source, less within the reach of our boldest stretch of thought.

I. Plants, animals, man, contain matter. Whence comes it? What does it effect in their tissues and in the fluids which bathe them? What becomes of it when death breaks the bonds by which its different parts were so closely united.

These are the questions which we touched upon together, at first with hesitation, for the problem might be far above the powers of modern chemistry; we afterwards considered them with somewhat more confidence, as we felt from the silent and inward assent of our understandings that the path was sure, and that we could descry the goal gradually standing out, clear of all that obstructed our vision. If from these labors which you have witnessed, or, I should rather say, in which you have taken part; if from this scientific effort there have arisen some general views, some simple formulæ, it is my duty to become their historian; but allow me the pleasure of adding, that they belong to you, that they belong to our school, the intelligence of which has been exercised on this new ground. It is the ardor with which you have followed me in this career that has given me strength to pursue it; it is your interest which has sustained me; your curiosity which has awakened mine; your confidence which has made me see, and which proves to me at this moment that we are still in the path of truth.

These remarks will remind you of the wonder with which we found that, of the numerous elements of modern chemistry, organic nature borrows but a very small number; that from these vegetable or animal matters, now multiplied to infinity, general physiology borrows not more than from ten to twelve species; and that all the phenomena of life, so complicated in appearance, belong, essentially, to a general formulæ so simple, that, so to speak, in a few words the whole is stated, the whole summed up, the whole foreseen.

Have we not proved in fact, by a multitude of results, that animals constitute, in a chemical point of view, a real apparatus for combustion, by means of which, burnt carbon incessantly returns to the atmosphere under the form of carbonic acid; in which hydrogen burnt without ceasing, on its part continually engenders water; whence, in fine, free azote is incessantly exhaled by respiration, and azote in the state of oxide of ammonium, by the urine?

Thus from the animal kingdom, considered collectively, constantly escape carbonic acid, water in the state of vapor, azote, and oxide of ammonium, simple substances, and few in number, the formation of which is strictly connected with the history of the air itself. Have we not, on the other hand, proved that plants, in their normal life, decompose carbonic acid for the purpose of fixing its carbon and disengaging its oxygen; that they decompose water to combine with its hydrogen, and to disengage, also, its oxygen; that, in fine, they sometimes borrow azote directly from the air, and sometimes indirectly from the oxide of ammonium, or from nitric acid; thus working, in every case, in a manner the inverse of that which is peculiar to animals? If the animal kingdom constitutes an immense apparatus for combustion, the vegetable kingdom, in its turn, constitutes an immense apparatus for reduction, in which reduced carbonic acid yields

its carbon, reduced water its hydrogen, and in which, also, reduced oxide of ammonium and nitric acid yield their ammonium, or their azote.

If animals, then, continually produce carbonic acid, water, azote, oxide of ammonium; plants incessantly consume oxide of ammonium, azote, water, carbonic acid. What the one class of beings gives to the air, the others take back from it; so that to take these facts at the loftiest point of view of terrestrial physics, we must say that, as to their truly organic elements, plants and animals spring from air, are nothing but condensed air; and that, in order to form a just and true idea of the constitution of the atmosphere at the epochs which preceded the birth of the first organized beings on the surface of the globe, there must be placed to the account of the air, by calculation, that carbonic acid and azote whose elements have been appropriated by plants and animals. Thus plants and animals come from the air, and thus to it they return; they are real dependences of the atmosphere.

Plants, then, incessantly take from the air what is given to it by animals; that is to say, carbon, hydrogen, and azote, or rather, carbonic acid, water, and ammonia.

It now remains to be stated, how in their turn, animals acquire those elements which they restore to the atmosphere; and we cannot see without admiring the sublime simplicity of all these laws of nature, that animals always borrow these elements from plants themselves.

We have, indeed, ascertained, from the most satisfactory results, that animals do not create true organic matters, but that they destroy them; that plants, on the contrary, habitually create these same matters, and that they destroy but few of them, and that in order to effectuate particular and determinate conditions.

Thus it is in the vegetable kingdom that the great laboratory of organic life resides; there it is that the vegetable and animal matters are formed, and they are there produced at the cost of the air.

From vegetables these matters pass ready-formed into the herbiverous animals, which destroy a portion of them, and accumulate the remainder in their tissues.

From herbiverous animals, they pass ready-formed into the carniverous animals, who destroy or retain some of them, according to their wants.

Lastly, during the life of these animals, or after their death, these organic matters, as they are destroyed, return to the atmosphere whence they proceeded.

Thus closes this mysterious circle of organic life at the surface of the globe. The air contains, or engenders, oxidized products, as carbonic acid, water, nitric acid, oxide of ammonium. Plants, constituting true reducing apparatus, possess themselves of their radicals, carbon, hydrogen, azote, ammonium. With these radicals they form all the organic, or organizable, matters, which they yield to animals. These, forming, in their turn, true apparatus for combustion, re-produce carbonic acid, water, oxide of ammonium, and nitric acid, which

return to the air, to produce anew, and through endless ages, the same phenomena.

And if we add to this picture, already, from its simplicity and its grandeur, so striking, the indisputable function of the solar light, which alone has the power of putting in motion this immense apparatus, this apparatus never yet imitated, constituted of the vegetable kingdom, and in which is accomplished the reduction of the oxidized products of air, we shall be struck with the import of these words of Lavoisier:

"Organization, sensation, spontaneous movement, life, exist only at the surface of the earth, and in places exposed to the light. It would seem that the fable of the torch of Prometheus was the expression of a philosophic truth which had not escaped the ancients. Without light, nature was without life, was dead and inanimate: by the gift of light, a beneficent God spread upon the surface of the earth organization, feeling, and thought."

These words are as true as they are beautiful. If feeling and thought, if the noblest faculties of the soul and of the intellect, have need, for their manifestation, of a material covering, to plants is assigned the framing of its web with the elements which they borrow from the air, and under the influence of the light which the sun, its inexhaustible source, pours in unceasing floods upon the surface of the globe.

And as if, in these great phenomena, all must be connected with causes which appear the most distant from them, we must, moreover, remark how the oxide of ammonium, the nitric acid, from which plants borrow a part of their azote, are themselves almost always derived from the action of the great electric sparks which flash forth in stormy clouds, and which (furrowing the air through a vast extent,) produce there the nitrate of ammonia which analysis detects in it.

Thus, from the craters of those volcanoes whose convulsions so often agitate the crust of the globe, continually escapes carbonic acid, the principal nutriment of plants; from the atmosphere flashing with lightnings, and from the midst of the tempest itself, there descends upon the earth the other and no less indispensable nutriment of plants, that whence they derive almost all their azote, the nitrate of ammonia contained in storm-showers. Might not this be called, as it were, an idea of that chaos of which the Bible speaks, of those times of disorder and of tumult of the elements, which preceded the appearance of organized beings upon the earth?

But scarcely are the carbonic acid and the nitrate of ammonia produced, than a form more calm, although not of inferior energy, comes to put them in action; it is light. Through her influence, the carbonic acid yields its carbon, the water its hydrogen, and the nitrate of ammonia its azote. These elements unite, organized matters form, and the earth puts on its rich carpet of verdure.

It is, then, by continually absorbing a real force, the light and the heat emanating from the sun, that plants perform their functions, and that they produce, this immense quantity of organized, or organic, matter—pasture destined for the consumption of the animal kingdom

And if we add, that animals on their part produce heat and force in consuming what the vegetable kingdom* has produced, and has slowly accumulated, does it not seem that the ultimate end of all these phenomena, their most general formula, reveals itself to our sight?

The atmosphere appears to us as containing the primary substances of all organization, volcanoes, and storms, as the laboratories in which were first produced the carbonic acid and the nitrate of ammonia which life required for its manifestation, or its multiplication.

In aid of these comes light, and developes the vegetable kingdom, immense producer of organic matter; plants absorb the chemical force which they derive from the sun to decompose carbonic acid, water, and nitrate of ammonia; as if plants realized a reducing apparatus superior to all those with which we are acquainted, for none of these would decompose carbonic acid in the cold.

Next come animals, consumers of matter and producers of heat and force, true apparatus for combustion. It is in them, undoubtedly, that organized matter puts on its highest expression. But it is not without suffering from it that it becomes the instrument of sensation and of thought; under this influence, organized matter undergoes combustion; and in reproducing the heat and the electricity, which produce our strength, and which are the measure of its power, these organized, or organic matters, become annihilated, in order to return to the atmosphere whence they came. Thus the atmosphere constitutes the mysterious link which binds the vegetable to the animal kingdom.

Vegetables, then, absorb heat, and accumulate matter which they have the power to organize.

Animals, through whom this organized matter only passes, burn or consume it, in order to produce in its aid the heat and the different powers which their movements turn to account.

Suffer me, therefore, if, borrowing from modern sciences an image of sufficient magnitude to bear comparison with these great phenomena, we should liken the existing vegetation (truly a storehouse in which animal life is fed,) to that other storehouse of carbon constituted of the ancient deposites of pit-coal, and which, burnt by the genius of Papin and Watt, also produces carbonic acid, water, heat, motion; one might almost say life and intelligence.

In our view, therefore, the vegetable kingdom will constitute an immense *depot* of combustible matter, destined to be consumed by the animal kingdom, and in which the latter finds the source of the heat, and of the locomotive powers of which it avails itself.

Thus we observe a common tie between the two kingdoms, the atmosphere; four elements in plants and in animals—carbon, hydrogen, azote, and oxygen; a very small number of forms under which vegetables accumulate them, and under which animals consume them; some very simple laws, which their connexion simplifies still more: such would be the picture of the most elevated state of organic chemistry which would result from our conferences of the present year.

You, like myself, have felt, that before separating we have need of

* "*Le règne animal*" in the original; but this is obviously an error.—Edit. *Phil Mag.*

collecting our thoughts, of fixing with precision all the facts, of bringing together and summing up the opinions which explain and develope these great principles; lastly, that it was useful, as regarded your future studies, to give you in writing, and in a clearer form, the expression of these views, which were partly brought into existence under the stimulus of your presence, and consequently reduced into form with the hesitation which so often accompany the first enunciation of our thoughts.

[TO BE CONTINUED.]

Description of a new Universal Photometer. By DR. CHARLES SCHAFHAEUTL, *of Munich, Assoc. Inst. C. E.*

The inadequacy of the photometric instruments invented by Pictet, Rumford, and others, is universally acknowledged. The bromide of silver, as used by Sir John Herschell, although extremely sensitive, is only slightly affected by artificial light.

These circumstances induced the author to complete the present instrument, which he contemplated about twelve years since.

The intensity of the undulations of gaseous fluids, as well as that of the air, is proportional to the amplitude of the oscillations, or, more properly, to the square of the amplitude.

A wave of light striking the retina must create a similar vibratory motion in the nerves of the retina, because the velocity of the molecular movement of the nerves depends upon the force with which they have been struck by the original wave, and if this velocity could be measured, it would show at the same time the intensity of light.

It is scarcely possible to obtain a direct accurate measurement of this velocity, but if the time during which the vibratory motion of the nerves ceases be ascertained, the velocity of the vibrating molecules, and, therefore, the intensity of light, may be determined, because the duration of an impression on the retina is dependent on the resistance which the molecules of the nerves oppose to every force striking them; but as this resistance of the nerves increases as the square of the velocity, four times the momentum, or intensity, is necessary to double the time of duration—or, in other words, the intensity of the pencil of rays is as the square of the time of the duration of that impression made on the nerves of the retina.

The new photometer consists of a brass bar fixed vertically in a stand, carrying at its upper end a small tube in two parts, which may be lengthened from five to ten inches, if requisite. This eye tube has at each end a sliding plate pierced with holes of corresponding diameters. From the bottom of the bar a projecting arm sustains the lower end of a strip of rolled steel, eighteen inches long, $\frac{6}{16}$ths inch broad, and $\frac{1}{32}$nd inch thick; this has at the upper end a thin plate, pierced with a small hole, corresponding with the holes in the sliders, and standing one-eighth of an inch from one of them: upon the main bar is a prism with a slit in it, through which the strip of steel passes; this prism can be moved up or down, by a rack and pinion, so as to lengthen or shorten the vibrations of the strip.

The method of using the instrument is to adjust the two holes at the opposite ends of the horizontal eye tube, so that they perfectly correspond, and do not permit any rays of light to enter, unless the plate at the extremity of the spring be pushed aside. The light to be compared is then placed at a certain given distance behind the plate, so that by bringing the axis of the hole which is pierced in it into the axis of the tube, a small pencil of light may enter the pupil of the eye. The prism is then placed at 100 of the scale on the side of the brass bar, and the steel strip caused to vibrate gently. A luminous disk immediately appears, accompanied by scintillations, which are caused by the impressions on the retina being interrupted by dark intervals: the prism is then gradually raised, until the length of the vibrations of the strip being diminished, and the velocity increased, the luminous disk appears perfectly steady and clear. The length of the vibrating portion of the strip is then read off by the verniers marked on the brass rod, and compared with the whole length of the spring, measured from 100, which is considered as unity. The number of the vibrations to be computed from the found length of the spring, are inversely to the numbers of vibrations of the whole length, as the squares of their relative lengths. Hence are constructed the formulæ for calculation, which are given at length in the communication.

A fresh luminous impression is made on the retina as often as the circular aperture in the screen, on the top of the spring, cuts the axis of the tube. If the duration of the small vibration of the nerves of the retina is shorter than the time of a vibration of the spring, a dark interval appears between the two luminous impressions. In this case the vibration of the spring is shortened until the next impression returns just as the first ceases, and therefore the dark interval disappears; then by measuring the length of the shortened spring, the number of vibrations can be computed, and from them the intensity of the light.—*Trans. of the Inst. of Civ. Eng.* Jour. of Arts & Sci. Nov.

Propagation of Sound.

M. Colladon has forwarded to the French Academy of Sciences an account of some experiments he had been making on the Lake of Geneva, relative to the propagation of sound; he had tried over again an experiment made by Mr. Bonnycastle, on the coast of the United States, in 1838, and recommended by M. Arago, in order to find whether sound could be reflected back from the bottom of a lake, or piece of water, and by measuring the time of its passage, to calculate the depth of the water. Mr. Bonnycastle had not been able to hear the sound of a bell under water at a greater distance than 8000 or 10,000 feet, but M. Colladon had succeeded in propagating a sound of this kind to the distance of 13,500 metres, or 42,640 feet; he had also found that when a blow was struck on a bell partly out of water and partly under water, two sounds were heard, one coming by the air, and the other by the water. At a little distance the latter was the less strong of the two, but at a great distance the contrary was the

case, and the sound transmitted by the water was the more intense; it could even be heard when that by the air was totally imperceptible; he was of opinion that, under favorable circumstances, sound might be transmitted through the sea for a distance of 100,000 metres, or upwards of sixty English miles. Mining Jour.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Harvey Leach's Suspension Railway Ferry and Drawbridge.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Suspension Railway Ferry and Drawbridge, invented by Mr. Harvey Leach, of Philadelphia, Pennsylvania, REPORT:—

That they have examined the outline drawings, and the model, submitted to the Institute by the projector, and find that his devices have two leading features, which make it convenient to treat them separately, as follows:

I.—*Of the Suspension Railway Ferry.*

Here the design is, to carry a railway across navigable waters, at such an altitude as to permit the free passage beneath it of ships under sail; to suspend from a large truck, running upon this railway, a fenced platform, of sufficient dimensions, and at a proper level, to receive passengers and freight from piers on both shores. This pendant deck, or platform, when required, is to travel from side to side—by the aid of suitable machinery, acting upon the truck carriage—and is thus designed to provide a means of transport over the water, at intervals longer or shorter, according to circumstances.

The two lines of rails are to be supported, each upon the inner side of the lower chord of a lattice truss of iron, very similar to that of Smart's well known bridge, patented in England, 4th of July, 1822,* and recommended by the patentee to be applied to pendant bridges, precisely as is here done. The antecedent patent, of Ithiel Town, January 28th, 1820, also covers lattice trusses of iron, as well as those of wood, so well known in this country.

Each of the trusses which carry the rails is proposed to be strengthened and sustained by chains, or cables, of iron, suspended in the usual manner from the summits of piers, which rise above the trusses for that purpose, and which are to be formed of pillars, kept separate as high as the rails, to allow a free transit of the pendant deck, in both directions.

In the lithographic engraving before us, several cables are represented as attached to one truss; they are arranged in different curves, one above the other, as in the wire bridge constructed by Mr. Ellet, at Fairmount; and in the particular plan referred to, it is not designed to secure the chains, or cables, to either bank, but simply to fasten

* London Journal (Newton's) of Science and the Arts, vol. v, page 233.

them to, or connect them with, the truss, at equal distances on both sides of the piers—the trusses projecting (for that purpose) towards the land, from each shore pier, a distance equal to about half the adjacent span. If the model in the hall of the Institute were sawn asunder, transversely, in the middle, the parts of the truss would remain balanced by the cables over each land pier as a fulcrum, and would in that case very closely resemble the trusses of the lattice suspension drawbridges used upon the railway between Philadelphia and Wilmington; and the same principle—that of balancing the bridge upon suspending bars, extending equal distances from the supporting piers—was long since used by Wernwag, the celebrated carpenter, in constructing a bridge across the Neshaminy Creek, in this State.

The *main details* of the project before us, cannot, therefore, be regarded as novel, and its *general features* appear to us to interfere with "Fisher's Suspension Railway," patented in England, 2nd of April, 1825,* which had in view the same object, viz:

"To construct railways by throwing chains from any two points, as over a river or ravine, or across a swampy ground; and to suspend from the catanarian curve of the chain, by means of perpendicular rods, a straight rail, upon the lower side ledges of which the wheels of carriages are to run."

These carriages in Fisher's patent (of which the form is not described,) were to be pendant below the suspension railway, and travel from shore to shore, like the hanging deck, or platform, of the project before us.

In view of these considerations, the Committee, whilst they cannot recommend Mr. Leach's project on account of its *novelty*, must (for obvious reasons) leave the question of its *utility* to be decided by its cost, and the particular circumstances of those localities, where such devices may be considered applicable, merely remarking, in conclusion, that the capacity of existing means of transportation across navigable waters, where common bridges are inadmissible, is such, as to leave but little to be desired, in point of speed and certainty—except where masses of ice present an obstruction to the progress of vessels propelled by steam.

II.—*Of the Suspension Railway Drawbridge.*

This is a modification of the other project, and is designed to be applied in chief to railways arriving at the banks of navigable waters, at an elevation so low as to preclude their passage without obstructing the navigation—such, for example, as the railway approaches to the Susquehanna River, at Havre de Grace. In these cases, Mr. Leach proposes to bring out the railway, from both shores, upon suspension bridges, to two very elevated piers upon the margin of the channel, some three or four hundred feet apart; to erect centrally between them, a third pier, of the same altitude—thus forming two channel spans—and to suspend from these three piers, by flat catenarian curves, a lattice truss, high enough to clear the shipping, and having movable, upon a railway thereon, a pendant platform, of the full

* London Journal (Newton's) of Science and the Arts, vol. xi, page 98.

length of one span; this movable span is to be wholly or partially withdrawn, into the other, whenever vessels are to pass. This is an application of Fisher's patent to a new use, and upon it must rest Mr. Leach's claim to *novelty* in this branch of his scheme.

From the summits of the tall marginal piers above mentioned, the cables, or chains, are to sweep down towards both shores in a catenarian curve, of which the land piers of suspension will be comparatively low, and the vertex, consequently, much nearer to the banks, than to the piers of the drawbridge.

From this description, it will be at once perceived that practical difficulties must flow from such a plan, owing to the inequality of the angles of inclination of the tangents of the catenaries, at the points of suspension, as well as to the unequal loads imposed upon the channel spans by the operations of the drawbridge; and it is a question not yet affirmatively settled in the minds of the Committee, whether suspension bridges are as suitable as others to carry the trains usually drawn on railways by locomotive steam power?—for it is certain that the attempts hitherto made to apply such bridges upon railways, have not succeeded, and it is probable that to render them successful (at least in such long spans as those of the project before us,) it would be necessary to increase the weight of the chains so prodigiously, as to render the expense too serious to be encountered in ordinary cases.

Under these circumstances, without entering further into detail, the Committee are not prepared to recommend Mr. Leach's drawbridge project for general use in navigable waters, though they incline to the opinion that, in a modified form, it may possibly be applicable in some cases, if its expense does not forbid its adoption.

By order of the Committee,

March 10*th*, 1842. WILLIAM HAMILTON, Actuary.

Grimes' Smut Mill.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Smut Mill, invented by Mr. William C. Grimes, of York, Pennsylvania, REPORT:

That they have examined the machine, and obtained such information relative to its practical efficiency, as was within their reach. The operation which it is designed to perform is one of peculiar difficulty, and has hitherto been executed very imperfectly. The smut balls, as they are termed by the miller, are so nearly of the same size and weight as the grains of wheat, that no means have ever been devised for removing them without first breaking or crushing, and afterwards riddling or winnowing, or both.

When the smut is thus broken, the finer portions of it have a tendency to adhere to the wheat, especially by insinuating into the cleft of the grain, and cannot then be removed. Mr. Grimes has contrived this machine with a view to remove the difficulty, by subjecting the smutted wheat, simultaneously, to the action of revolving beaters, which shall break the smut, and a strong current of air, which shall

blow away the fragments before they can attach themselves to the grain.

The beating is effected by thin cast iron webs, fixed longitudinally on the exterior of a vertical cylinder, which revolves within a cylindrical cast iron case, the inner surface of the case being fluted longitudinally, to prevent the grain from being carried directly around with the revolving cylinder, and cause it to rebound repeatedly when it has been thrown against the case by the centrifugal motion communicated by the beaters.

The interior cylinder extends a few inches above the top of the surrounding case, and the webs which form the beaters are here expanded radially, so as to form vanes for the production of a strong upward current of air in the annular space between the cylinders.

The grain to be cleaned enters this space near the upper end; as it descends by gravity, the smut is broken by the beaters, on the well known principle of the increased resistance of a fluid medium in proportion as the mass of the penetrating body is diminished, the powdered smut is blown out at the top, while the larger grains of wheat descend and escape through an opening below. Beside the main features now described, there are several minor devices, which are ingeniously adapted to lessen certain practical difficulties, particularly those to prevent the blowing out of the wheat before it has acquired sufficient downward velocity to resist the blast, and the dangerous tendency to overheating the upper journal, which deserve commendation; but as they do not constitute any part of the general principle, it is not thought necessary to complicate the report with a particular description of them.

From a mere inspection of these several contrivances, the Committee would be inclined to form a favorable opinion of their adaptation to their intended object; but as the cleaning of smutted wheat is an operation which cannot be reduced to any certain rules of mechanics, and can, therefore, only be judged of by experiment on a practical scale, inquiry has been made of parties using the machine, and it has been examined in actual use. The result of this inquiry and examination has fully confirmed the good opinion of the Committee, and they feel warranted to commend the machine to the notice of millers, as capable not only of making good white flour from wheat so badly smutted as to be generally considered unmerchantable, but which will also improve the general quality of his flour by the removal of cheat and of the down, or furze, which covers one end of the grain, and of most other accidental foreign matters which tend to injure the quality of the flour.

In conclusion, the Committee take pleasure in recommending this invention to the Managers of the Institute for an award of the Scott's Legacy premium.

By order of the Committee,

March 10*th*, 1842. WILLIAM HAMILTON, Actuary.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Railroad Carriages;* Albert Bridges and Charles Davenport, Cambridgeport, Middlesex county, Massachusetts, May 4.

This improvement is in the manner of suspending the body of the car to the frame, so as to give it a free oscillating, or pendulous, motion, which may be checked by side springs, to avoid the unpleasant and injurious jarring motion, occasioned by the striking of the flanches of the wheels against the rails.

Claim.—"We claim supporting the carriage, or body of the same, upon, or connecting it to, the wheel frame, by means of the rough braces, or pendulous bars, or links, either suspended or not, at pleasure, to springs on the wheel frame, and arranged according to the modes represented (all of which modes permit a lateral motion of the running machinery, independent of the body of the carriage,) in combination with the side springs, opposed to said lateral motion, and which are disposed and operate substantially, in the various ways described."

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2. For an improvement in the *Press for Cheese, &c.;* Damon A. Church, Friendship, Alleghany county, New York, May 4.

The follower of this press is forced down by means of a weight, the cord from which is attached to, and actuates, a double ratchet wheel, which has its shaft hollow, and is received on to a shaft carrying two double scroll wheels, one on each end. The cords are then conducted in such a manner over pulleys, as to effect the pressure by means of the weight; but the arrangement cannot be readily described in words alone, and we therefore pass to the claim.

Claim.—"What I claim, and desire to secure by letters patent, is the manner in which I have arranged and combined the respective parts thereof, so as to accomplish the desired end—that is to say, the manner in which I have combined the double ratchet wheel with the shaft—the (double scroll) wheels and the cords winding around said shaft, and passing over the pulleys in the movable pieces; by which combination and arrangement, the weight which is attached and suspended, in the manner described, produces a progressive and continuous pressure upon the cheese, or other article to be pressed. It will be manifest that considerable difference may be made in constructing this machine without departing from the general principle, or mode of action, upon which it is dependent; I do not intend, therefore, to limit myself in this particular, but to vary this machine as I may think proper, while I produce the same effect, by means substantially the same."

3. For improvements in the *Horse Power* for driving Machinery; J. Francis Moore, Falmouth, Stafford county, Virginia, May 4.

In this machine there is to be a main horizontal wheel, which is to be drawn round by the horse, and this has truck rollers attached to the under side of its rim, which run on circular rails on a suitable platform. This wheel, by means of cogs on its inner periphery, drives a small wheel, to the axis of which is affixed another large wheel, which runs on truck rollers on a second platform, and, by means of cogs on its inner periphery, drives a pinion, or small cog wheel, from the shaft of which motion may be communicated to a thrashing machine, &c.

Claim.—"What I claim is the manner in which I have combined and arranged the respective parts thereof—that is to say, I claim the combination of the two wheels with the two platforms and with each other, in such manner as that said wheels shall be supported on their respective platforms by trucks, or friction wheels, and revolve thereon without the aid of axles, or gudgeons. I claim, also, the particular arrangement and combination of the four wheels, in the manner set forth—the two larger wheels having cogs, or teeth, on the interior of their rims, and mashing into, or engaging with, the two smaller, by an arrangement of the respective parts, substantially the same with that herein described."

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4. For an improvement in the *Harvesting Machine,* for cutting, thrashing, and winnowing Grain; Damon A. Church, Friendship, Alleghany county, New York, May 4.

On the forward part of this machine there is a set of V shaped cutters, with points that separate the heads of the grain from the straw; above these cutters there is a gathering wheel, with strips that reach from end to end, to catch the heads of the grain, as the gathering wheel revolves, and force them against the V cutters, which separate them from the stocks. The heads of grain are delivered from the cutters on to an endless apron, which extends along behind the cutters until it arrives at a point where it meets two endless aprons, between which the grain is conducted up to a thrashing machine, of the usual construction; from the thrashing cylinder the grain and straw are discharged on to an endless apron of netting, with meshes sufficiently small to prevent the passing through them of the thrashed heads, but allowing the grain to fall upon another endless apron, which carries it back, until it falls down in rear of a fan wheel, by which the chaff and dirt are blown out, whilst the grain descends into a box. The cutters are each hung upon a joint pin at the heel, and are borne up against the gathering wheel by a spring.

The claim is to the "manner of constructing the knives, or cutters, so as to hang each of them upon a rod, or joint pin, whilst they are each sustained by a spring, as described." Also, to the combination of the apron that receives the grain from the gathering wheel, with those that conduct it to the thrashing cylinder; and, finally, to the

endless apron of net work that receives the grain, &c, from the thrashing cylinder, with the one that conducts the grain to the fan.

5. For an improvement in *Mill Spindles and Vertical Shafts;* Jacob Staub, Georgetown, District of Columbia, May 4.

The patentee says:—"The object which I design to obtain by my improvement, is to have less friction, and to give better opportunity to repair the end of the spindle."

At the bottom of the step, or ink, there is a movable *plug*, which runs up into a hole made in the bottom of the spindle, or shaft, the upper part of the said hole being occupied by another movable plug, which has a small hole through its whole length, to receive and conduct oil from the box, in which the whole works—the oil escaping through a lateral hole in the lower end of the shaft, or spindle. As the whole weight of the shaft rests on these two removable plugs, the wear will be confined to them, and when worn, they may be removed and replaced by others, simply by taking out the spindle.

Claim.—"What I claim as my invention, and improvement, and which I desire to secure by letters patent, is the arrangement of the lower removable plug in the step, or bed, in combination with the upper removable plug, in the spindle, or shaft, and provided with a hole to admit oil from the box, for the purpose, and in the manner, specified."

6. For an improvement in the manner of constructing *Paddle Wheels* for Steamboats; P. G. Gardiner, New York City, May 4.

"On each of my paddle wheels I use a double row, or series, or a greater number, of buckets; which buckets are placed so as to form an angle with the axis of the wheel; and I deem it best to place them so as to stand at an angle of forty-five degrees, or nearly so, with said axis, or shaft; but a variation of from four to five degrees from this angle may be made without materially interfering with the action of the wheel. In constructing my wheel with a double row, or series, of buckets, there must be three sets, or series, of arms, the middle being twice as numerous as the two outer series, the buckets of each outer series meeting in the middle. I do not claim the mere placing of the buckets in such a manner as to form an angle with the axis, or shaft, of the wheel—this having been done, but with other views, and under arrangements differing from those adopted by me;—but what I do claim as constituting my invention, and desire to secure by letters patent, is the placing of a double series of buckets so to form an angle of forty-five degrees, more or less, with the axis of the wheel; said buckets having each of their inner ends attached to a distinct arm, thus allowing a free or open space between each bucket, in each series of buckets, as set forth; said buckets being convoluted in consequence of their being attached to radial arms, in the manner described."

7. For improvements on his *Cap Spinner;* also applicable to others; Charles Danforth, Paterson, Passaic county, New Jersey, May 4.

The lifters in this cap spinner, as in that originally patented by Mr. Danforth, are worked by arms radiating from the main driving shaft; on each end of the said driving shaft there is a grooved pulley, from which a band runs to two inclined grooved pulleys on each end of the lifter, and passes along in front, and returns along the back, of the lifter—it being supported, as it passes, by guide pulleys, ranged along the front and back edges thereof. On this belt the bobbins rest, and by it they are driven. The inclination of the inclined groove pulleys must be such as to receive the band from, and return it to, the grooved pulleys on the ends of the main shaft, in a proper direction, to prevent them from running off. The spindles are oiled along that part of their length over which the bobbin passes, by means of a tube attached to the lifting rail, which dips into an oil cup at the bottom of the dead spindle, and spreads the oil as it ascends with the lifting rail.

Claim.—"The principle of this invention, for which I claim a patent, consists of the combination of the main shaft, and pulleys thereon, with the inclined pulleys on the lifters, and the pulleys and radius rods, carrying, sustaining, and guiding, a band, or cord, so as to drive the bobbins resting on the band, or cord, at the required rate and force, the bobbins being constructed and kept supplied with oil, as aforesaid, substantially as above. I also claim the method of supporting, guiding, and working, said endless band, or cord, by means of the inclined carrying pulleys on the lifters, and the grooved end pulleys in connexion with the grooved pulleys on the main shaft, thereby giving motion to the bobbins, by causing an endless band, or cord, to pass under them, with their weight bearing on said band, or cord, substantially as aforesaid, by whatever mechanical means the regulating action, effected by the radius rods, may be produced. I also claim the reciprocating motion given to the grooved end pulleys by means of radius rods, studs, and brackets, essentially as herein described. I also claim the method of applying oil to the spindles and bobbins, in spinning machinery, substantially as above described. And I further claim as my invention, the use of inclined pulleys upon lifters, carrying and guiding a band, or cord, upon which bobbins are made to rest and to be turned, substantially as aforesaid, by whatever mechanical means the said band, or cord, may be guided to and from said inclined pulleys, as the said lifters rise and fall in the operation of any spinning machine to which said inclined pulleys, bands, or cords, may be applied. I also claim the combination of pulleys, whether inclined or not, upon the lifters, with a band, or cord, and bobbins, resting upon them, and carried by said band substantially as aforesaid. I also claim the combination of pulleys, inclined or not, upon spindle rails, carrying, guiding, and moving bobbins, by the weight of these, on a band, or cord, as aforesaid."

9. For a machine for *Separating Gold from its Ores;* Thomas Seay, Columbia, Georgia, May 4.

This machine is very similar to others which are used for the same purpose, differing from them in some particulars which have been deemed sufficient to become the foundation of a patent; the following is the claim:

"What I claim as my invention, and desire to secure by letters patent, is, constructing the rocking trough, or amalgamator, with an undulating surface on its bottom plank, in combination with the top plank, provided with pins, and fitting into said trough, which will produce the desired effect.

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10. For an improvement in *Bee Hives;* Constant Webb, Willingford, New Haven county, Connecticut, May 4.

The claim on which this patent was granted, gives the character of the improvement with sufficient distinctness; we deem it unnecessary, therefore, to offer any other description of it.

Claim.—"I do not claim as my improvement the movable bottom merely, nor the suspension of the hive for protection from the moth, as both are common; but I do claim as my invention and improvement, and as new and useful, the peculiar form of the construction of the hive, by making the front board shorter than the sides and back, so that the bottom is made to slide in, and rest on cleats attached to the inside of the sides, and can be wholly drawn out for the convenience of hiving bees, and when hived, can be replaced, and the hive closed without shaking it or disturbing the bees, till the hive and its contents are safely removed to their proper station; all which I claim, in combination with the mode of suspending the hive so as to make the bottom an inclined plane, while the top and body of the hive project forward, to protect the bees from storms, &c., all as described."

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11. For improvements in the *Fanning Mill,* for cleaning Wheat from smut, garlic, &c.; David Philips and Asa Jackson, Franklin Mills, Mercer county, Virginia, May 4.

This machine is constructed for the purpose of separating, by a current of air, the pure wheat from garlic and other impurities, the specific gravity of which may be less than that of wheat.

The grain passes in a thin stratum down an inclined plane, to a vertical flue, or aperture, where it is met by a strong current of air, from a fan, which deflects the various materials, according to their specific gravity. Below the flue there are three vertical plates, the first being immediately under its forward part, and the other two at appropriate distances apart—thus forming two flooms—the upper edges of the last two being armed with sliding plates, or regulators, which are bent forward towards the current of air. The pure wheat, which is said to be the heaviest, will fall between the first and second vertical plates, the next heaviest between the second and third, and all the light impurities will be discharged at the back part of the machine.

Claim.—"What we claim as new, and of our own invention, and which we wish to secure by letters patent, is the construction of the winnowing machine, or fan, with a vertical flue, or aperture, as set forth; in combination with the inclined plane, and the vertical plates, the two first being governed by regulators."

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12. For an improvement in the *Seed Planter;* Joseph Gibbons, Adrian, Michigan, May 4.

A patent was granted to Mr. Gibbons, for a seed planter, on the 25th of August, 1840, and is noticed in this Journal, vol. ii, 3rd series, page 258. The improvement referred to in the above title, is added to this patent. The patentee says:

"My improvement is intended to be applied to the said machine (referred to above) when it is constructed for the purpose of planting a single row of seed. With this intention, I make perforations in several rows around a planting cylinder, which holes are to vary in size and number according to the nature of the seed to be planted. Above this cylinder I place a hopper for containing the seed, which hopper is so formed and arranged as to be capable of being slid along from end to end of the planting cylinder, so that the opening on its lower side, through which the seed is to pass into the cavities, or excavations, in the planting cylinder, may be made to stand directly over either of the rows.

"Having thus fully described the nature of my improvement in my planting machine, what I claim therein, and desire to secure by letters patent, is the manner in which I have formed and combined the planting cylinder and hopper, as above set forth—that is to say, a cylinder having several rows of cavities, or excavations, around its periphery, with a hopper placed above it, and made capable of sliding along it, substantially in the manner, and for the purpose, set forth. I also claim the manner of placing the guide wheel in front, and on one side of the machine, so as to allow of its being readily tilted, to cause the share to make a furrow of greater or less depth."

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13. For an improvement in the manner of *arranging the Keys of a Piano Forte;* John Dwight and Daniel B. Newhall, Boston, Massachusetts, May 6.

The above named improvement is for "curving the front ends of the keys, and arranging them on a curved line." The patentees say: "The nature and character of our improvements are to facilitate the execution of music on the piano forte and other keyed instruments, particularly when the bed of keys is long, consisting of six, seven, or more octaves, by which a performer is enabled to reach the extreme keys more conveniently."

Claim.—"What we claim as our joint invention and improvement, is the concave curvature of the bed of keys in front, as described."

14. For an improvement in *Door Locks;* John P. Sherwood, Sandyhill, Washington county, New York, May 6.

This alleged improvement in door locks consists in the mode of moving the bolts by means of a weight instead of by a spring. The weight, which works the latch bolt, and which is called a *car* by the patentee, slides at an angle of about forty-five degrees with the bottom edge of the lock, on a stud pin, and on the spindle of the knob, it being provided with two slots for that purpose; this weight is connected with the rear end of the bolt, by a connecting link of a peculiar form.

Claim.—"I do not claim the employment of a weight to work the latch bolt, as a substitute for a spring—that having been previously done; but what I do claim as my invention, and desire to secure by letters patent, is the method of working the bolt by means of the sliding inclined car, as described, and also the mode of connecting the latch bolt with the sliding car, by means of the link, for the purpose, and in the manner, described."

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15. For improvements in the machine for *Removing Obstructions, or Bars, from Harbors, Rivers, &c.;* James R. Putnam, New Orleans, Louisiana, May 11.

The sand, mud, or other earthy obstructions, at the bottom of rivers, &c., is first to be loosened, by drawing through it a series of ploughs, attached to a frame, which is provided at its back with a number of cutters, to subdivide the furrows made by the ploughs. After the obstructing earth, &c., has been loosened as above stated, a second machine is dragged over it, in order to remove it; this machine consists of two inclined scrapers attached to a frame, one behind the other, and in front of each scraper there is a plate, the upper edge of which is jointed to the frame. When this machine is passed over the earth, the jointed, or swiveled, plates, are closed up, leaving a narrow space between their edges and the scrapers, through which the earth, sand, &c., is forced, and is thereby lodged on the plates, and when the whole is drawn into deep water, the weight of the contents opens the jointed plates, and thus the earth is discharged. These two machines are suspended by chains to two boats, the forward boat being used to drag, and the back one to regulate the depth to which the machines shall sink.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the scrapers with the swivel plates, for the purpose, and in the manner, described. Also, the arrangement of ploughs, in combination with the cutters, for the purpose, and in the manner, described."

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16. For an improvement in the *Washing Machine;* George Waterman, Johnston, Providence county, Rhode Island, May 11.

This machine consists in part of two dashers, that are worked up and down in a trough, or box, by two levers, and by tappets on a

shaft, which act on one end of the said levers, the other end passing through a loop on the handle of each dasher. At the bottom of the box in which the dashers, or pestles, work, there is a rocking false bottom, which is called a vibrating bottom, and is pierced with small holes, for the passage of the water that is to be squeezed out of the clothes, which are placed on the said false bottom, and upon which the dashers fall.

The claim is to the "vibrating bottom, in combination with the dashers," as specified.

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17. For improvements in *Hot Air Furnaces and Fire Grates;* William H. Whiteley, Charleston, Suffolk county, Massachusetts, May 11.

The claim in this instance refers throughout to the drawings, and is, therefore, omitted. It is confined to two improvements, the first of which consists in an arrangement of flues for heating the air that is to be conveyed to the apartments to be heated, and the second to an arrangement of the grate, in combination with a catch, which answers the double purpose of holding the grate in its place, and of scraping off the cinders in cleaning out the fire chamber.

The fire chamber is surrounded by two concentric cylinders, except where the door is placed for the admission of coals, &c., with a space between each—the inner cylinder being pierced with holes. The fire chamber is covered by a plate, in which are inserted tubes for the passage of the draught, and of the air to be heated. The cold air is admitted into the outer space around the fire chamber, from which it passes, through the holes in the inner concentric cylinder, to the chamber surrounding the fire cylinder, thence into some of the flues above the fire chamber, which are surrounded by the draught flues, that carry off the gaseous products of combustion into the chimneys; and the heated air is conducted by pipes, governed by dampers, into the apartments to be warmed.

The grate is made with side pieces, or cheeks, of a wedge-like form, that slide on inclined bed pieces, and the catch, which holds the grate in its place, is hinged to the furnace, directly in front of the grate, and catches in a mortise made for that purpose. When the grate is drawn out, the catch drags over the top of the bars, and clears off the cinders.

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18. For an improved method of constructing *Cocks for Hydrants;* Ebenezer Hubball, Baltimore, Maryland, May 11.

This improvement consists in a method of constructing the piston of the valve and the screw pipe through which it slides, and by which it is secured to the cock and valve seat, so that the screw cap may be unscrewed, and the valve and piston removed from above, without removing the hydrant; all which is to be effected by making the piston square, or polygonal, and fitting it into a hole of the same form, in the screw cap, instead of making it round, as heretofore.

The claim is confined to the above described improvement, and the

patentee says:—"Although I make use of the terms square and polygonal, I would conceive my patent infringed by the use of any shape of piston and opening in the screw, whereby the same power to unscrew and screw in again, without disturbing the hydrant, would be obtained."

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19. For an improvement in the *Smut Machine*, for cleaning Grain; Jacob Dimuth, Benjamin Banman, and Levi Beck; the two former of Lancaster township, and the latter of Lampeter, Lancaster county, Pennsylvania, May 11.

To a suitable shaft are attached four metal disks, placed at given distances apart, and four sets of bars, passing through holes in, and attached to them, constitute four open beaters, extending, radially, from the shaft to the periphery. The four spaces, into which the diameter is divided, between the two inner disks, are occupied by four similar beaters, the bars of which are of smaller size than those first named. The spaces between the two inner, and the two outer, disks, are occupied by solid beaters, consisting of plates, some of which are parallel with the axle, and others placed obliquely. This beating apparatus revolves within a drum, or cylinder, the periphery of which is formed of triangular bars, and which revolves in a direction the reverse of that of the beater—the whole being placed horizontally.

The claim is to the beater, constructed in the manner stated, "in combination with the cylinder, constructed with angular straps, as described, the beater and cylinder revolving horizontally, and in opposite directions."

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20. For an improvement in the *Wind Chest for blowing the fires of Forges and Furnaces;* Charles Foster, Rochester, Monroe county, New York, May 11.

The patentee says:—"I disclaim the original invention of the bellows box, and what I claim as my invention, and desire to secure by letters patent, is the method of constructing the top of the box by forming it with two oblong apertures, or tubes, inclined towards each other, for the purpose of concentrating the draught of air, and increasing its power of action on the fire."

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21. For an improvement in *Paddles for propelling Boats;* Samuel Swett, Jr., Chelsea, Suffolk county, Massachusetts, May 11.

"The paddles, or buckets, by which the propelling is to be effected, are attached to frames which stand horizontally, and which are made to vibrate back and forth, and are raised up and down by means of cranks. The paddles, or buckets attached to the vibrating frames, would, were they immovably affixed thereto, dip into, and rise from, the water vertically; but instead of so attaching the paddles to vibrating frames, I hang them upon pivots, which admit of their having a vibrating motion communicated to them, independently of that which they receive with the frame. The intention of this is to cause them

to enter, and to leave, the water in a direction varying a few degrees from a vertical line; and this they are made to do by means of eccentrics upon the ends of the cranks which carry the vibrating frames, there being shackles, or connecting rods, from said eccentrics, leading to, and connected with, one or more of the paddles. I intend, in general, to use two vibrating frames, each carrying three paddles, on either side of the boat, or other vessel.

"What I claim as constituting my invention, and desire to secure by letters patent, is the giving to the paddles, or buckets, in the particular kind of apparatus herein described for propelling boats, or other vessels, an independent vibratory motion within the vibrating frames to which they are attached, for the purpose of causing them to enter, and to leave the water in a line inclined from the perpendicular, as described.

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22. For an improvement in the *Machine for Packing Tobacco;* Thomas Samson, Richmond, Virginia, May 11.

This apparatus consists of four staves of cast iron, or other metal, cast hollow, their outer surfaces being segments of a circle, and their inner surfaces straight. The edges of these staves, where they come together, are united. These staves are placed one against each side of the tobacco box, and by means of hoops and wedges, they and the box, and the tobacco within, will be drawn together.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructing and using of four staves, or billets, of cast iron, or other metal—said staves being cast hollow, and having their contiguous edges formed with a mitre joint, or in such a manner as will admit of their being drawn together by means of bands, or hoops, by which they and the contained box are to be embraced when in use."

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23. For an improvement in the *Argand Lamp, for burning Spirits of Turpentine, &c.;* John S. Tough, Baltimore, Maryland, May 11.

"The reservoir and burner are made in the usual manner of Argand's lamp, except the outer cylinder of the latter, which is made about an inch higher than the inner cylinder, and slightly flaring outward. The principal improvements are in the construction and arrangement of a sliding cylinder, which fits the inner cylinder of the Argand's burner, having its upper end enlarged, so as to fit the space between the inner and outer cylinders of the burner being flared outward, so as to press the wick against the inside of the outer cylinder, which is also made slightly flaring outward, as before noticed, provided with a funnel-shaped button, or inverted conical regulator, which slides up and down, for concentrating the air around the flame, and increasing its intensity, and a glass globe, with a circular rim inside the same, made in the form of a hollow frustum of a cone rising inward from the lower rim of the globe, for contracting the space and impinging the column of air around the flame; the slope of said flanch extending downward from the flame, outside the wick, whilst the

slope of the button extends also down from the flame, but inside the circle of the wick.

"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the conical rim at the bottom of the globe, with the inverted cone regulator, or button, and adjustable cylinder, adapted to, and combined with, the wick case, as set forth."

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24. For an improvement in the *Self Sharpening Plough*; Isaac Snider, Carrollton, Pennsylvania, May 11, 1841; which improvement was added to a patent granted to him on the 29th of July, 1837, noticed in this Journal, vol. xxi, 2nd series, page 273.

The claim in this instance refers throughout to the drawings, and is therefore omitted. The first item claimed is to the making a groove in that part of the mould-board which is hollowed out to receive the share, there being a projection on the share to fit into the said groove. The second item is for making the cutter with two hooks, one to hook on to the neck of the mould-board, and the other to hook below the point, to "support the same; by means of which arrangement, the cutter serves as a clamp to hold the mould-board and point together." The third item is for making the cutter in two separate pieces, with a depression to admit a movable blade, fastened in by two rivets, "which enables the farmer to change the edge from wrought iron to steel." And the last item is for making the share in two pieces, with a tenon in front, to receive a movable blade, for the same purpose for which the cutter is made in two.

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25. For an improved apparatus, called a *Walking Aid*, for the relief of persons who are unable to walk, from weakness of the knee or ankle-joints; Stephen P. W. Douglass, Williamson, Wayne county, New York, May 15.

This apparatus resembles, in its general features, others which have long since been in use for the same purpose, and which are well known to surgeons. The apparatus consists of side plates running along the side of the thigh and leg, jointed together at the knee, and attached to the hip, the knee, and the foot, by appropriate straps, &c. There is a spring which bears on the thigh and leg plate, and which is connected with the knee joint by means of a screw, said screw serving to increase the tension of the spring, which thus constantly tends to straighten the knee. The knee joint of the apparatus is connected with the limb by means of a "patella cap," which embraces the knee above and below, one side being hooked to the screw, where it forms the connexion with the apparatus, and the other to a strap that passes under the limb, but not in contact with it, and is attached to the screw, where it passes through the spring—thus avoiding the binding of the limb all around, which would tend to arrest the circulation of the blood. The attachment to the foot is by means of straps that pass under the foot, around the heel, and over the in-

step, and then to a bow-piece attached to the lower end of the side plate. There are various modifications described in the mode of applying the spring, by substituting, for that above named, a helical or a volute spring; and also a modification of the mode of attaching the apparatus to the foot, which would require drawings to make them clear.

This apparatus, as described by the patentee, has been the result of long and painful experiment on his part, and has been gradually brought to its present improved form, for the relief of his own sufferings. Without it he would not be able to walk, not even by the aid of the best instruments for the purpose previously constructed; but by means of his own improvements, he is enabled to move about with considerable facility.

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26. For a machine for *Making Posts and Fences from Clay;* Mercy Wright, Tullytown, Bucks county, Pennsylvania, May 15.

At each end of a suitable frame, provided with two sets of rails, or tracks, for the passing of a car, there is a revolving platform, with rails corresponding with those on the frame. A car, the upper part of which contains, or is formed into, a mould, runs upon the rails; and by means of cogged wheels which take into a rack, attached to the under side of said car, it is drawn under a roller which compresses the clay into the mould, and then under a scraper which takes off the surplus clay. When the car reaches the platform at one end, the mould is removed, the platform turned, and the car passed on towards the opposite platform, where the mould is again filled with clay, and the whole operation repeated.

Claim.—"What I claim therein, and desire to secure by letters patent, is the manner in which I have constructed, combined, and arranged the machine for the purpose of moulding and pressing brick clay, so as to form the parts of fences, as set forth; that is to say, I claim the manner in which I have combined the two revolving platforms, the railways, the car with its moulds, and the roller and scraper, substantially as set forth, so that said parts shall co-operate in effecting the object of their construction."

This machine, it appears, is the contrivance of a female, and we wish that its utility was equal to the skill with which its parts are arranged; but we cannot believe that posts made of brick clay, having mortises in them, and that rails of the same material, fitting into said mortises, will ever be used to surround and divide a plantation. The material will be too fragile, however well it may be baked, and would be liable to break down under the man who should attempt to climb it.

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27. For an improvement in the machine for *Extracting Stumps of Trees*, and for removing buildings; Luke F. Cavanaugh, Newfield, Tomkins county, New York, May 15.

"The nature of my invention consists in arranging a strong screw

in a perpendicular position in a suitable frame, to the head of which screw is attached a sweep, or lever, moved by animal, or other, power, and by which the screw is turned in a movable nut, on which an inclined movable bar rests, and to which the chain, made fast to the stump, is attached, so that as said nut rises on the screw, the end of the bar also rises, and the stump is drawn from the ground; said frame being placed on a carriage of four wheels, for the purpose of moving it from place to place."

"What I claim as my invention, and desire to secure by letters patent, is the bed piece and movable bar, in combination with the screw nut and carriage, as described."

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28. For an improvement in the *Straw Cutter;* John B. King, Athens, McMinn county, Tennessee, May 15.

The knife which cuts the straw, in this machine, is hung at each end to a crank; the shaft of each crank having a fly wheel, and a band wheel, with a band passing from one to the other, for the purpose of causing the two cranks to revolve at the same time.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of hanging the knife on two pivots that are placed in the two cranks, each having a separate fly wheel attached to it, which balance wheels receive a simultaneous motion, produced by means of two drums that are coupled together by a band."

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29. For an improvement in the process for *Removing Wool and Hair from the Skins of Animals;* Francis and Hanson Robinson, Wilmington, Delaware, May 15.

"We do not claim the use of any particular apparatus for carrying the same into effect, but employ such instruments and means as are now known and used for other purposes; but what we do claim, and desire to secure by letters patent, is the process of loosening the wool, or hair, from skins, or hides, by the direct application of steam thereto; said skins, or hides, being suspended in any suitable room, or apartment, into which steam can be admitted."

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30. For an improvement in the construction of *Pumps;* William M. Wheeler, Liberty, Clay county, Missouri, May 15.

The lower part of the barrel of this pump is of much greater diameter than the upper, and the piston is made to fit into both; that part fitting the small barrel is made hollow, and is provided with a valve at its upper end, where it is connected with the piston rod. When the piston is drawn up it acts as a lifting pump, the water flowing in to fill up the vacuum in the lower, or larger, part of the barrel, and this, on the descent of the piston, is forced up through the hollow piston into the small barrel; and as the lower barrel is of greater diameter than the upper, the water received in it during the descent of the pis-

ton, will more than fill the small barrel, and hence the water will be forced out at the top.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the barrel with an enlargement below, and having a plunger with an aperture in its centre, adapted to said enlargement, in combination with a hollow piston, or stem, attached to said plunger, and passing up through a portion of the smaller diameter of the pump barrel, having a valve at its upper end to close the aperture in it, through which the water mounts on the descent of the plunger, by which arrangement the apparatus is constituted a lifting, as well as a forcing, pump; in other words, what I claim is constructing the apparatus in such a manner that on every descent of the piston rod a vacuum, or space containing no water, is formed in the pump above the plunger, the object of which is to admit a sufficient quantity of water on every ascent of the piston rod, to keep a constant stream flowing at the discharging pipe, as described."

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31. For an improvement in the manner of making the *Joints of Clothes Horses;* Harvey Luther, Providence, Rhode Island, May 15.

The above named patent is for a method of making the hinges by which the frames of clothes horses, called by the patentee clothes stands, are united. The side pieces of each frame are made round, and the two that are to be hinged together have a groove around them, near the top and bottom, the groove being deep enough to receive a cord, or chain, which passes around one of them, is then crossed, passes around the other, and is fastened on the inside.

The patentee says—"I am aware that clothes stands, &c., have been hinged by means of cords, or straps, attached to square rods, so as to allow them to fold in either direction, and I do not, therefore, claim this as my invention, but what I do claim, and desire to secure by letters patent, is the peculiar manner in which I make the hinges, that is to say, I claim the making the rods constituting the frames which come together, with grooves in them, in combination with the method of uniting them by means of cords, or chains, in the grooves, as described."

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32. For improvements in *Horizontal Wing Piano Fortes;* Frederick C. Reichenback, Philadelphia, Pennsylvania, May 19.

The claim is to the "manner of constructing and arranging the wrest pin block, and the wrest pins, so that the latter shall pass entirely through the former, and receive the wires at their lower projecting ends;" and also to the "manner of constructing, arranging and combining wrought iron braces with the wrest plank and straining board, said braces passing over the wrest pin block, bearing against its back edge, and resting at their rear ends on the straining pin plate."

33. For an improvement in the *Recumbent, or Library, Chair;* Henry P. Kennedy, Philadelphia, Pennsylvania, May 19.

The improvement above named is in that kind of recumbent chairs in which the seat slides in the frame, and is clearly indicated in the following claim, viz:—"What I claim as my invention, and desire to secure by letters patent, is the combination of a spiral spring, or springs, with the rails and sliding seat of a recumbent chair, which will allow the seat to be forced forward, and the back to assume a reclining posture, and which will restore the seat and back to their ordinary position when the force is removed, as described."

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34. For improvements in the machine for *Moulding and Pressing Bricks;* Waldren Beach and Ephraim Lukens, Baltimore, Maryland, May 22.

In this machine the moulds are arranged in a horizontal wheel, and pass under a hopper, from which they receive the tempered clay; they then pass under a pressing roller, which is in connexion with the hopper, its sides embracing that portion of the roller which presses the clay. As the moulds advance they pass under a knife, which is hung to an arbor and is pressed upon by a spring, which knife cuts off the surplus clay, whilst it yields, in the event of meeting with a stone. A projection from the under surface of the pistons that form the bottom of the moulds, is acted upon by an inclined plane that forces the bricks out of the moulds, and then as the wheel continues to rotate, the bricks are, by means of a guide, delivered on to a belt, by which they are carried off to any desired place of delivery. After the moulds have been emptied, they pass under a rotary sieve to be sanded, and thence to the hopper. The filling of the moulds is effected by two pallets, called by the patentee cams, each of which is hung to a shaft that passes across the lower part of the hopper, and through its side, and is there connected with a weighted lever, which lever projects from the shaft in the same direction with the pallet. The axes of these pallets being above the surface of the mould wheel, the weighted levers will cause their extreme ends to bear on the surface of the wheel, and as the moulds pass under, the clay is forced into them by the inclined surface of the pallets. The axles of the pallets are provided on one side with a knife to cut off the clay to the proper width.

Claim.—"What we claim as our invention and improvement, and which we desire to secure by letters patent, is—First. The rotating horizontal wheel, in combination with the duster. Second—The box, or casing, round the bottom of the pressing roller, in combination with the horizontal wheel and hopper, in the manner set forth. Third—The combination of the horizontal wheel with the cams in the bottom of the hopper, the said cams having attached to them a knife inside the hopper, and a weight, or lever, outside of the same. And fourth—We claim also the manner of combining the pressing roller with the hopper, in the manner described, viz: by arranging

the said roller on the outside of the hopper, and connecting it with the same, by means of the casing surrounding said roller, as set forth."

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35. For an improvement in the *Churn;* Enos Mitchell, Pittston, Kennebec county, Maine, May 22.

This churn has double dashers, which are to be operated upon by two bent levers.

The claim is to the "method of combining the two dashers of the churn by means of the two bent levers, and the connecting rod, operated by the arm on the rock shaft."

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36. For improvements in the manner of operating the *Cotton Gin;* David Phillips, Georgetown, Mercer county, Pennsylvania, May 22.

The frame of this cotton gin is placed on wheels, and is called by the patentee a car body. The wheels run on a circular rail, the body being supported by a beam projecting from a vertical shaft, that has its bearings in the centre of the platform, to which the circular rail is attached, and in a frame above. The forward wheel is to guide the car, or gin, body, and the hinder is to operate the gin, by means of a large belt wheel attached to, and turning with it, which is connected with the roller, or cylinder, of the gin by a belt.

Claim.—"I claim, as my invention, the car body described, so constructed as to receive the seed and clean cotton, in combination with the supporting and guide wheels, arranged and operating substantially as described."

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37. For *Maintaining Power* to drive machinery; Stephen P. W. Douglass, Williamson, Wayne county, New York, May 22.

The object of this machine is to receive and regulate any irregular, or intermitting, power obtained from any source, and to give it out regularly, as may be required. Two endless chains, placed side by side, are each passed around two wheels, placed one above the other. A pinion, attached to a suitable sliding frame, is situated between the two chains, with its teeth taking into their links; and to this sliding frame is suspended a heavy weight. The irregular, or intermitting, force is applied to the shaft of one of the wheels, acting on either of the chains, which, by its operation on the pinion, winds up the weight, provided the other chain be held permanent, but as this weight tends to turn this chain, one of its wheels is connected with, and actuates, any machine requiring to be moved with regularity. If the power applied be equal to that given out, the pinion, with its weight, will remain in the same position, and will simply transmit the power which it receives; but if the former exceeds the latter, the pinion and weight will be raised, and when the former becomes less, then they will sink. In this way it will be seen that the winding up of the weight does not prevent it from giving out its full force, as it is always suspended to the chain which gives out the power.

Claim.—"What I claim as new, and desire to secure by letters patent, is the manner in which the two endless chains are arranged, and connected, and are combined with the respective wheels, or pinions, and with the weight to be raised, and with the machinery to be propelled, so as to obtain a regular propelling force, either from an intermitting motive power, or from a continuous irregular power, as herein described."

38. For an improvement in *Files for Filing Newspapers, &c.*, called the "Movable Binder;" Isaac Detterer, Philadelphia, Pennsylvania, May 22.

This movable binder consists of two sides of a book cover, and to the back edge of one of which two screws are attached, that pass through two holes in the other cover; the papers, pamphlets, &c., to be filed, or held between the covers, are placed between them, and by means of two handles, provided with screw nuts, the whole is held together. The handles are split, and spring apart, like crayon holders, and have a slide to close them, their inner ends being provided with threads to fit the screws.

Claim.—"I claim, as my invention, the combination of the book cover, the screws, and the movable handles, for the purpose of binding and unbinding, at pleasure, letters, newspapers, music, &c.

39. For an instrument for taking measure of the body, preparatory to cutting coats, called the *Tailors' Measure;* Lyman B. and Ellery Miller, Middletown, Orange county, New York, May 29.

The patentees say, "We are aware that there are a number of measuring instruments consisting of elastic strips of metal, and which are attached to the person whose measure is to be taken; we do not, therefore, make any claim to the individual parts of our instrument, But we do claim the combining of four strips of metal, which are to stand horizontally when the instrument is in use, with four others which are to stand vertically, the whole of which slips are made adjustable by means of sliding sockets, and have one measuring tape attached to them."

The left hand vertical strip is placed in the middle of the back, and its upper end is provided with a strap that passes around the neck; the second at the back of the shoulder, the third in front of the shoulder, and the fourth in the middle of the breast. The lower horizontal strip passes around the waist, the second under the arms, (the end of each of these being provided with a strap to pass entirely around the body,) the third extends from the middle of the back to the shoulder, to measure the extreme width of the back, and the fourth passes over the shoulder and unites the upper ends of the second and third vertical straps. A strap is attached at the junction of the second horizontal and the third vertical strip.

40. For an improvement in the *Wind-Mill;* William Zimmerman, Stephenson, Rock Island county, Illinois, May 29.

This patent was obtained for a mode of regulating the inclination of the sails, as the wind increases or decreases, by means of "the centrifugal governor." The sails of the wind-mill are all connected with a disk, at one end of a sliding rod, which rod passes through the centre of the shaft of the sail wheel, it being made hollow for that purpose; the end of the sliding rod opposite to the disk is provided with a rack, said rack being acted upon by a pinion that receives its motion from the slide of the governor. The increased velocity of the wind wheel will throw out the balls of the governor, which, by their connexion with the sails by means of the sliding rod and disk, increases their inclination, and thus lessens the action of the wind upon them, and consequently retards the motion of the mill.

Claim.—"What I claim therein as of my invention, and desire to secure by letters patent, is the weathering of the sails by the action of the sliding rod, or piston, and the disk, operated upon by the governor substantially in the manner set forth, whether said disk be made to operate upon the sails by means of the rods, by racks and pinions, or by any other device which is the same in principle, and producing a like effect, by means substantially the same."

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41. For an improvement in the *Counter Twist Speeder;* Jesse Whitehead, Manchester, Chesterfield county, Virginia, May 29.

"The nature of my invention and improvement consists in the application of the revolving block, or driving drum, directly to the metallic guide which is placed in front of the twisting belts, or bands, for twisting the roping, which is delivered as it passes through the guide directly against the block, and near the centre thereof, horizontally, and conveyed from thence between the guide and block to the bobbin placed above the block, and in contact therewith—the said guide being grooved, or channeled, along its concave side to admit the roping, for the purpose of keeping it in its compressed state, as it leaves the twisting belts."

"What I claim as my invention, and desire to secure by letters patent, is the before described mode of delivering the twisted roving in the compressed state in which it leaves the twisting bands at a uniform and regular tension, by means of the aforesaid combination and arrangement of guide, block, and bobbin. I also claim the construction of the metallic curved and channeled guide, as described."

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42. For improvements in the machine for *Riving and Shaving Shingles;* William S. George, Baltimore, Maryland, May 29.

"The timber from which the shingles are to be made by my machine, is to be cut of the proper length, and rived out so as to constitute square bolts, of such size as shall adapt them to the width of the shingles to be formed from them. These bolts are to be placed in a frame prepared to receive them; a piece of the proper thickness for a

shingle is then rived off by means of a reciprocating knife, which piece falls upon a table below the riving knife, whence it is driven forward between two dressing knives, which, as it passes between them, are made to approach towards each other in such manner as to give a regular taper to the shingle, the edges being jointed at the same time, by jointing irons duly fixed for that purpose."

The knife that rives the shingle is attached to a sliding frame with two tables, one of them forward of the knife to gauge the thickness of the shingle to be rived, and the other level with the top surface of the knife, to support the block. The shingle is then forced between two sets of knives, the one set being permanent for dressing the edges, and the other set for shaving the surfaces, which are so arranged as to approach each other as the shingle passes through, to taper it.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the frame for holding the bolts with the vibrating frame, its panels, and riving knife, so as to rive shingles from the bolt, as described. I also claim the within described manner of constructing and combining the dressing and jointing apparatus, the dressing knives being made to approach other, and the jointing frames being affixed and operating substantially as above described."

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43. For a mode of *Treeing Boots;* Elias Hall, Jr., Spencer, Worcester county, Massachusetts, May 29.

The boot tree, after the boot is placed upon it, is put upon a bench properly adapted to it, and the rub-stick is connected with a lever, or sweep, by a swivel, or hinge joint, so as to allow it to take any required position, whilst the lever, or sweep, to which it is attached, can only move up and down, and vibrate to and fro. The upper end of this lever is connected with a standard by a rod attached to said standard, and sliding in a slot, the end of the rod being enlarged and fitting in a hole bored in the end of said lever, such hole being of greater diameter than the width of the slot, so that the lever, with the rub-stick, may slide up and down, and be retained by the enlargement on the end of the rod.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the rub-stick with the sweep in the manner described, said sweep having a swivel joint and a hinge joint, to allow the rub-stick to adapt itself to the inequalities of the boot. Also the method of combining the sweep and rub-stick with the standard by means of the rod, having a boll on its end, adapted to a groove, or slot, on the upper end of the sweep, as set forth."

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44. For an improvement in the *Press for Compressing Hay, Cotton, &c.;* Charles W. Hawkes, Brunswick, Maine, May 29.

The follower of this press is operated by racks and pinions in the usual manner; but the racks, there being two of them, are attached to uprights that work on the outside of the box, and are connected

with the follower by a cross beam which extends from one upright to the other.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which the racks are combined with the follower of the press, by being attached to the uprights outside of the box, and connected with each other, and with the follower of the press, by the cross beam."

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45. For an improvement in the *Pump;* Sidney S. Hogle, Lansingburgh, Rensselaer county, New York, May 29.

In the barrel of this pump there are two pistons, the rod of one passing through the other, so that as one piston descends the other rises, and vice versa, by which a constant stream of water, which passes through a valve in the upper piston when it descends, is kept up. The two pistons are operated by means of two spiral fillets, or grooves, called by the patentee cams, or eccentric grooves, made in a vertical drum, or enlarged part of a shaft, which act upon rollers on the ends of the piston rods.

Claim.—"What I claim as my invention is the combination of the suction and lifting pistons so as to produce an alternate action, as described, by means of the shaft constructed with cams, or eccentric grooves, and the rollers attached to the head of each piston rod, as described."

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46. For an improvement in the *Tobacco Press;* Thomas G. Hardesty, Tracey's Landing, Ann Arundel county, Maryland, May 29.

"In my improved tobacco press, the hogshead in which the tobacco is to be pressed has both heads removed, and it is placed horizontally upon the frame of the press, resting upon two long, longitudinal pieces of timber near the ground, prepared to receive it; and two false hogsheads, or receiving cylinders, the same in diameter, or nearly so, with the hogshead, are placed upon the same longitudinal pieces in a line with it, said hogshead being situated between them. The hogshead and the two false hogsheads are to be filled with tobacco by hand, and may be made to contain the whole quantity that is required to be packed in the hogshead. When thus prepared, pressure is to be made at each end of the apparatus, by means of two screws, which force up two followers, said followers entering and passing through the false hogsheads, and forcing all the tobacco which had been placed in them for that purpose, into the hogshead situated between them. The false hogsheads are so constructed as to admit of their being removed from the press without its being necessary to retract the pressing screw; and this I effect by uniting the staves which constitute the false hogsheads to bands, or hoops, of iron, which are clasped together at their ends, and when unclasped, are to spring open sufficiently far to admit of the escape of the false hogsheads over the shaft of the screw."

"What I claim, and desire to secure by letters patent, is the manner

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in which I construct and employ the two false hogsheads by placing them horizontally in a range with the hogshead to be packed, and pressing simultaneously from each end, as set forth. I also claim the so arranging of the parts of the press, as that two followers may be forced up, one from each end thereof, by means of the pressing screws operated by female screws, or boxes, attached to the power wheels."

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47. For an improvement in the manner of constructing *Saw Mills*; Jeremiah Rohrer, Rohrersville, Washington county, Maryland, May 29.

In this improved mill there is one roller above, and another below the stuff which is being sawed, for the purpose of supporting it, this being necessary in sawing light stuff. The upper roller has its bearings in a piece of timber, which is hinged to another piece that slides in a suitable frame above the log. The hinged piece, with its roller, is so hung that it will yield only when the carriage runs back, but not when it is moving towards the saw. The roller may be removed from the log by means of a cord, which passes over a pulley and extends within reach of the tender of the mill. The lower end of the sliding piece, in which the lower roller has its bearings, rests upon a second sliding piece, which is jointed to a lever, to draw it away and allow the roller to slide down, the upper end of which lever is acted upon by the carriage, when the saw approaches the end of the stuff, and thus allows the saw to cut through the end of the stuff.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the two rollers for making pressure upon the upper and lower parts of a log, when being sawed in a saw mill. I am aware that a single roller has been used for supporting a log, but this has not been made to operate in the manner described by me, nor do I know, or believe, that there has previously existed any combination similar to that herein described, by which two rollers were made to co-operate in sustaining the stuff. I do not claim, therefore, the employment of a single roller under the log; but I do claim the manner in which I have made the lower roller to operate, by causing the same to rise and fall vertically, and to be made self-operating when it is to be removed from under the log, the respective parts thereof being constructed and arranged in the manner set forth, and being used in combination with the upper roller as described."

Specifications of American Patents.

Specification of a Patent granted to Ross Winans, *for an improvement in the mode of Regulating the Waste Steam in Locomotive Engines, November 26th,* 1840.

To all whom it may concern: be it known that I, Ross Winans, civil engineer, of the city of Baltimore, in the state of Maryland, have

invented an improvement in the manner of constructing locomotive engines, by which improvement the action of the waste steam may be so regulated as to increase or diminish the draught of the furnace, at pleasure, whilst the engine is in operation and the locomotive under way; and I do hereby declare that the following is a full and explicit description thereof:

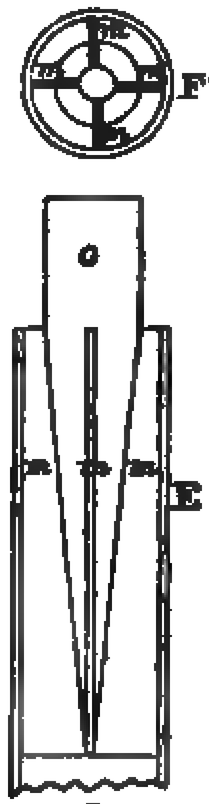
In the locomotive steam engine, as ordinarily constructed, the steam, after it has performed its office in the cylinders, is, under the name of waste steam, conducted through pipes, denominated waste pipes, into the chimney of the engine, and is suffered to escape from these pipes in a vertical direction, so as greatly to increase the natural draught through the fire, and thereby to augment the quantity of steam produced. It is a matter of great importance, however, in the arrangement of the engine, to be able to regulate the amount of this increased draught, so as to increase or diminish the power of the engine according to the various circumstances to which it is subjected when in use. It is obvious, for example, that to take a loaded train of cars up an ascending grade, requires more power than is necessary to propel it along a level, and that in a descending grade it is frequently desirable that the power should be diminished; there are other circumstances, also, as is well known to every competent engineer, under which the ability to regulate the power of the engine is not only desirable, but of vast importance.

The force with which the steam will escape from the orifices of the waste pipes, into the chimney, is determined by the elasticity of the steam, and the size of the orifices of the escape pipes; and by being able to change the latter, the velocity with which the steam shall issue may be determined, and with this, also, the augmentation, or diminution, of the draught, will be regulated. In the construction of this part of the engine, as heretofore made, it has been the aim of the builder so to proportion the size of the orifice of the waste pipes, as that the steam shall issue from them with what may be denominated a medium velocity; which, however, under the same elasticity, could not be varied, as the orifices were to remain of the same determinate size.

Now, my invention consists in a contrivance by which the engineer is enabled—in those engines in which the draught is increased by the discharge of the exhaust steam into the chimney, and while the engine is in motion—to increase or to diminish the draught in the chimney, at pleasure, by enlarging or contracting the orifice of the pipes there, so as to adapt the draught to the occasion, regulating the head of steam generated to the particular exigency.

In the engine in common use, the escape pipes, by which the steam passes from the cylinders into the chimney, are contracted in size at their upper ends, forming the orifice herein mentioned. In my invention, I propose to give them an uniform diameter throughout, say three or four inches, according to circumstances, as shown in the accompanying drawing. Where A and B, fig. 1, represent the escape pipes, and C the chimney of a locomotive, in each of these pipes I place an inverted cone, *o, o,* made of metal, the upper end of which terminates in a cylinder, the diameter of which cylinder is so adjust-

ed, with reference to the diameter of the escape pipe, as to allow between them, when the cone and cylinder are in the escape pipe, as small



2.

a space for the escape of the steam as is at any time allowable, so that when the cone and cylinder, which, for brevity, I term a damper, is in the position represented in the drawing, fig. 1, the steam passes into the chimney with the greatest velocity, and the draught is the greatest. It will be seen at once, by inspection of the drawing, that when the damper is raised, a part of the cone less in diameter is brought in a horizontal line with the top of the escape pipe, and the opening for the steam to pass into the chimney is increased, and that in proportion as the damper is raised, until, when the point of the damper is lifted to a line with the top of the pipe, the escape of the steam into the chimney is unrestrained by it, and of course the least increase of natural draught is obtained.

A contrivance by which the engineman can, at his pleasure, raise or lower the dampers, will enable him, therefore, to open or contract the orifices of the pipes, and, consequently, to regulate the draught according to the particular emergency. This may be effected in various ways well known to machinists. One that would answer the purpose is exhibited in fig. 1, where the engineman, by turning the winch X, moves the bent lever *y*, which, in its turn, raises, or sinks, the damper *o*. In order to steady the dampers, and keep them properly adjusted in the pipes, I affix three or four wings to each damper, extending from the apex to the base of the cone; these wings,

which consist of thin plates, stand in the direction of the radii of the horizontal section of the cone, and their outer edges touch the inside of the pipe. They are represented at *m, m,* in the drawing, fig. 2. To make the motion of the dampers simultaneous in both pipes, their upper, or cylindrical, portions, are connected, by extending one of the wings up the adjacent sides of said portions, so that one of the wings is common to the two dampers, as at *n, n,* fig. 1. Further to steady and guide the said dampers, a rod may be made to pass between the two pipes, so as to slide within a tube placed there for the purpose, as shown in fig. 1, at *k*; to the upper part of which rod, one of the arms of the bent lever already mentioned may be attached, by means of which, the dampers may be raised or lowered. D, fig. 1, is a plan showing the pipes and the tube between them, without the dampers. E, fig. 2, is a representation of the pipe enlarged, with the damper in it. F is a plan of the pipe enlarged, showing the damper and its flanches.

Fig. 3 exhibits a section of a chimney, and two exhaust pipes, showing another modification of my contrivance for producing the same result. The dampers here, instead of being inverted cones, are in such a form as to operate like direct cones, and the opening between them, and the sides of the pipe, instead of being the smallest that is allowable, when the dampers are depressed, is the largest; and it is by raising, not by sinking, the dampers, that the opening is decreased, and the draught increased. In fig. 3, the dampers, in place of being steadied in the pipes by flanches, as in fig. 1, are shown as steadied by a prolongation of the rod to which the bent lever is attached, downward, through a hole in a piece of metal, which is placed for that purpose, in the pipe, below the damper, as at *k*, it being so formed as to serve as a guide to the said rod, as already observed. There may be many contrivances for opening and closing the orifice of the pipes, beside the two above described; these two, however, will answer the purpose, and illustrate my object.

I do not claim the plan of increasing the natural draught, by causing the steam from the cylinders to enter the chimney, through diminished orifices; but I do claim as my invention, desiring to secure the same by letters patent, the plan of increasing or diminishing the force with which the steam from the cylinders enters the chimney, at the pleasure of the engineman, while the engine is in use, or motion, by

enlarging or contracting the orifices of the escape pipes, increasing or diminishing thereby, at pleasure, the draught of the chimney, in the manner above set forth—not intending, by this claim, to limit myself to the precise arrangement of the respective parts, as herein described, but to vary the same, as I may think proper, whilst I attain the same end, by means substantially the same.

ROSS WINANS.

Practical & Theoretical Mechanics & Chemistry.

Theory of Saponification.

Aware of the importance of investigating the theories involved in the chemical arts, with a view to their ultimate improvement on scientific principles, we had formed the design of imbodying the later observations of chemists on the oily substances, when an essay of Prof. Liebig's appeared in the "Annalen der Chemie and Pharmacie," for March, 1841, which contains an excellent view of the theory of saponification; we, therefore, translate the essay, nearly entire.

J. C. B. and M. H. B.

What was known of the nature of saponification, previous to the commencement of the present century, amounted to nothing, excepting the important discovery, by Scheele, of the *sugar of fats*, now called the *hydrated oxide of glyceryl*, (glycerule.) Chevreul began, in 1813, a series of investigations on soaps, which have not only thrown a clear light on this portion of chemistry, but have also led the way to the most brilliant discoveries in the whole province of organic chemistry. We are indebted to him for the present predominating principle in all organic researches, viz: to subject a body to a series of changes, and to ground its composition on the ascertained connexion of these changes.

Chevreul proved that all fats comprehended under the terms grease, oil, and tallow, consist of three materials united in the most varied proportions, one of which, *oleine*, at common temperatures, and below 32° Fahr., is always fluid, the others solid, the one called *stearine*, the other *margarine*—distinguished from each other by their melting points, and the different acids they give rise to by decomposition. These fatty substances are each composed of a peculiar fat acid, united to a compound oxide, the oxide of glyceryl, and being salts, are subject to decomposition, like ordinary salts.

Decomposition ensues when a fat, i. e. a compound of oxide of glyceryl, is treated with an alcali, or with oxide of lead or zinc; the alcalies, or metallic oxide, combining with the fat acid—the former constituting soluble salts, or soap; the latter insoluble salts, or plasters. The oxide of glyceryl, at the moment of its separation from the fat acids, takes up water and forms hydrated oxide of glyceryl.

The weight of the hydrate of glyceryl, added to that of the hydrated fat acids, amounts to more than the weight of the fat employed; the increased weight arising from the water entering into combination with the glyceryl and fat acids.

In the saponification of fats by alcalies, no other products are formed, and the operation is conducted equally well in vacuo, or in the air. With strong alcaline lyes, the soap separates from the concentrated fluid, and collects on its surface, while the glyceryl remains dissolved in the alcaline solution. The soap remains dissolved in a weak and hot alcaline lye, but on cooling, the whole congeals to a gelatinous, translucent mass.

Soaps are *solid and hard*, or *soft*. The last are obtained from drying oils, and contain potassa as a base, and to give them more consistence, tallow and fat oils are added, which form solid soaps. The hard soaps contain soda, and are prepared with fat oils, tallow, &c.

Soda soaps are made in England and France directly by soda and fats, in Germany by decomposing potash soaps with chloride of sodium. Commercial soaps from vegetable fats consist of oleated and margarated alcalies; those from animal fats are salts of stearic, margaric and oleic acids, with an alcaline base.

Potassa and soda soaps are readily soluble in hot water and alcahol; the addition of a quantity of water to the aqueous solution produces a precipitation, the neutral salts of stearic and margaric acids decomposing into free alcali, which remains in solution and acid steorate and margarate of alcali, which precipitates in form of pearly, crystaline scales.

Potassa soaps are more soluble in water than those containing soda. Stearate of soda may be regarded as the type of hard soaps, and when in contact with ten times as much water, it suffers no striking change. Stearate of potassa forms a thick paste with the same quantity of water. Oleate of soda is soluble in ten parts of water; the oleate of potassa dissolves in four parts, and forms a jelly with two parts, and possesses such a strong affinity for water, that 100 parts absorb 162 in a moist atmosphere. Margaric acid acts similarly to stearic. It follows from this that soaps are soft in proportion to the oleates, and hard in proportion to the stearates and margarates they contain. Soda soap exhibits a peculiar behaviour to a solution of common salt; it loses the power of being penetrated by, or dissolving in, a solution of salt of a certain strength, and this remarkable action is an important condition in its manufacture, on which depends the separation of all free alcali and oxide of glyceryl, its content of water, and the state in which it is brought into the market.

If a piece of common hard soap, cut into pieces, be put into a saturated solution of salt, at ordinary temperatures, it swims upon the surface without being moistened, and if heated to boiling, it separates without foam into gelatinous flocculæ, which collect on the surface, and upon cooling unite into a solid mass, from which the solution flows off, like water from fat. If the flocculæ be taken out of the hot fluid, they congeal, on cooling, into an opaque mass, which may be pressed between the fingers into fine laminæ, without adhering to them. If the solution be not quite saturated, the soap then takes up a certain quantity of water, and the flocculæ separate through the fluid in boiling. But even when the water contains $\frac{1}{400}$ of common salt, boiling produces no solution.

If the soap be boiled in a dilute and alcaline solution of salt, and suffered to cool, it again collects on the fluid in a more or less solid state, depending on the greater or less concentration of the solution, i. e., on the quantity of water taken up by the soap. By boiling the dilute salt solution with soap for a considerable time, the watery flocculæ swell up, and the mixture assumes a foaming appearance; but still they are not dissolved, for the solution separates from them. The flocculæ, however, have become soft and pasty even after cooling, and their clamminess depends more or less upon the quantity of water they have taken up. By still continued boiling this character again changes, and in proportion as the water evaporating renders the solution more concentrated, the latter again extracts the water from the flocculæ; the liquid continues to foam, but the bubbles are larger. At length a point is attained when the solution becomes saturated; before this, large, iridescent bubbles are observed to form, and in a short time all foam disappears; the liquid continues boiling without foam, all the soap collects in a translucent mass on the surface, and now the solution and soap cease to attract water from each other. If the plastic soap be now removed and cooled, while the solution is pressed out, it has become so solid as scarcely to receive an impression from the fingers. In this state it is called ***grain-soap***, (Kernseife.)

The addition of salt, or its solution, to a concentrated alcaline solution of soap in water, precipitates the soap in gelatinous flocculæ, and the mixture behaves precisely like solid soap boiled with a dilute solution of salt. Carbonated and caustic potassa act exactly like salt by separating soap from the alcaline fluid, in which it is absolutely insoluble.

The application of the above to the manufacture of soap is evident. The fat is kept boiling in an alcaline lye until all pasty matter disappears, but the lye should only have a certain strength, so that the soap may be perfectly dissolved in it. Thus tallow may be boiled for days in a caustic potassa-lye, of spec. grav. 1.25, without saponifying; if the lye be stronger, a partial saponification takes place, but being insoluble in the fluid, it floats upon the surface in solid mass: by the gradual addition of water and continued boiling, at a certain point the mass suddenly becomes thick and clammy, and with more water a kind of emulsion is formed, (Seifenleim,) which continued heating renders perfectly clear and transparent, if a sufficient quantity of alcali be present. In this state it may be drawn into long threads, which, on cooling, either remain transparent, or are more milky and gelatinous. As long as the hot mass suffered to drop from a spatula exhibits a cloudiness, or opalescence, the boiling is continued, or more alcali added. When excess of alcali is present, the cloudiness arises from imperfect saponification, or want of water; the former is shown by dissolving a little in pure water, which becomes perfectly clear when the whole is saponified; if the lye contain lime, the mixture is also clouded, but the addition of carbonated alcali instantly clarifies it.

In order to separate the soap from water, free alcali, and oxide of glyceryl, a large quantity of salt is gradually added to the boiling

mass, on each addition waiting until it is dissolved; the first addition increases the consistency of the mass, while each successive portion renders it more fluid, till it loses its threading character, and drops from the spatula in short thick lumps. As soon as the congelation is complete, i. e., when gelatinous flocculæ separate from a clear watery liquid, the fire is extinguished, the soap suffered to collect on the surface, and cooled either on the liquid, or ladled out, and suffered to get solid.

In the former case it is impure from water, free alcali, and other impurities of the lye, and is therefore illy adapted for commerce, although sufficiently good for domestic purposes. As in other chemical operations, a precipitate is purified by boiling it in a fluid in which it is insoluble, so soap is purified by a solution of salt rendered alcaline.

The soap of the first boiling is either re-dissolved in weak alcaline lye, and precipitated by salt several times, or it is boiled with an alcaline solution of salt several times, by which means it is rendered much purer. When the saponified fluid is made with potassa, the salt (chloride of sodium) operates in a two-fold manner: it dissolves in the pasty liquid, and decomposes with the potassa salts of the fat acids, forming on the one side chloride of potassium, and on the other soda, or soda-soap. That a decomposition takes place is evident from the altered consistency of the fluid mass. Since chloride of potassium has not the property of separating soda soap, a larger quantity of salt is added. When potassa-lye is employed in soap making, the first salting requires more than twice the quantity of salt.

In the preparation of potash soaps, a concentrated potassa lye is employed for separating the soap. Acetate, or tartrate of potassa, may be employed on a small scale. In the manufacture of soaps, the saponification of the fats is not completed by the first treatment with weak lyes; and the subsequent repetition of fresh lyes, beside purifying, also renders saponification more perfect.

In saponifying olive and other oils, the mixture often attaches itself to the bottom of the vessel, and is burned; in these cases the alcaline lye is previously mingled with salt, so that the forming soap is obtained in a state of fine division, and yet prevented from forming a perfect solution. For common house use, soap of the first boil is only treated once with salt; that for commercial purposes is suffered to swell up in a weak salt lye, by means of which it takes up fifteen to twenty per cent. water. Grain soap (Kernseife of the Germans) is generally colored bluish, or greenish, from sulphuret of iron, or copper, or from iron, or copper-soaps. By cooling, these coloring matters collect more or less in certain points, which gives a marbled appearance to the hard soap. Marbling is generally produced by the addition of sulphate of iron, or peroxide of iron, to the still soft mass.

For white soap, it is rendered fluid by heating it in a saline, alcaline lye, and kept in the covered vessel until all the coloring matters have subsided. The more water the soap has taken up in this operation, the more perfect the separation of the impurities, the whiter the soap. Now, since this water is not separated, but sold in the soap,

it follows that it has much less real value than the grain soap. The white soap contains from forty-five to seventy, marbled soap from twenty-five to thirty-five per cent. water.

The manufacture of soft soap is the simplest of all. The drying oils, either alone, or mixed with train oil, tallow and other fats, are kept boiling with dilute potassa lye until the saponification is completed, i. e., a mass is formed which draws into long transparent threads. Particular care is had in its preparation to the dilution of the lye, for all soft soaps are insoluble in moderately strong potassa lye, and may be precipitated from their solution by the addition of strong lyes. The fluid would therefore appear cloudy, milky, with an excess of strong lye, and by adding water would become pasty, or gelatinous. A deficiency of alcali produces an acid oleate of potassa, which attaches itself in thick masses to the bottom of the vessel; but an addition of lye changes it into a neutral salt. Oxide of glyceryl is not separated from soap, although it might be done by the final use of strong alcaline lyes.

The soft soaps of commerce have a greenish, or greenish brown color; they are transparent in thin laminæ, shining, soft but not fatty to the touch, of a peculiar odor, and have an alcaline re-action. Tallow is often added to them, which disseminates crystaline particles of stearate of potassa; communicating to them a peculiar grained character. Chevreul and Thenard found in commercial soft soap 39.2 to 44 per cent. oleic and margaric acids, 8.8 to 9.5 potassa, and 46.5 to 52 water. They always contain hydrated oxide of glyceryl and delphinate of potassa, derived from train oil, whence their peculiar odor.

When an alcaline soap is mingled with an earthy, or metallic, salt, voluminous white, or colored precipitates ensue, in which the alcali is replaced by the earth, or metallic oxide. Thus the salts of lime, magnesia, &c., throw down lime, magnesia, &c., soaps. Hence the curdling appearance, when soap is used with hard waters, arises from the union of the lime, or magnesia, they contain, with the fat acids. If carbonate of lime be in the water, it may be thrown down by a little caustic potassa, or lime, which will render it softer; if sulphate of lime, or a magnesia salt, be present, pearlash (ash-lye) will separate the earths.

TO THE EDITORS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Mr. Samuel Seaward's Remarks on Auxiliary Steam Power.

Gentlemen:—I have a few observations to offer upon Mr. Samuel Seaward's paper, abstracted from the Transactions, British Engineers, inserted in your valuable Journal for December, 1841, and in the American Repertory for December, 1841, which will shew how necessary it is to examine, and to separate the theoretical remarks from the facts in that paper.

At page 412, vol. ii, 3rd series, Journal Franklin Institute, Mr. Seaward remarks, "A quadruple increase of power will not produce

double the original velocity of a steam ship, although in theory such is assumed to be the case, for as the weight is more than doubled, the immersed section becomes greater, and a still further increase of power becomes necessary."

In this quotation, obscure though it be, it does not in the least appear that Mr. Seaward intended to say, that quadruple power will be insufficient to produce double the original velocity in a steam ship having the same immersion; but on the contrary, he supposes that quadruple power was sufficient, yet in the table calculated by Mr. Cubitt, and appended to Mr. Seaward's paper, it is assumed throughout, that eight times the power is required to produce double velocity in a steam ship, having the same constant immersion.

Thus in one quotation, four times the power, and in the other quotation eight times the power, is assumed to be necessary to produce a similar effect.

As this question is important, and can so easily be mechanically determined by experiment, it is very singular it should remain undetermined, as it is the fruitful parent of many absurdities, and surely none can be greater than one lately advanced, namely, that the resistance to vessels moving in water increases as the square of the velocities, but the power requisite to overcome that resistance, increases as the cube. Such contradictory statements, however eminent their authors, cannot be deemed either luminous, instructive or creditable.

Presuming your wish is to uproot error, and to increase the sum of knowledge, I beg to offer you the following experiments, to set this subject at rest.

Having at hand a small, but broad, cistern, I caused two short and heavy model boats to be drawn through the water by different weights attached to threads, passing under and over appropriate pullies, and found that when one boat had passed over a certain space, the other boat, drawn by a double weight, had passed over double space—or over double the space the first boat had passed over, in the same time; and I found corresponding effects produced when lighter, or heavier, weights (similarly proportioned) were employed.

As in all these cases the double weights descended double distances in the same time, double weight, multiplied by double descent, was equal to the expenditure of quadruple power for double velocity of the model boat.

These experiments having been very rudely questioned, because made on a small scale, I repeated them in a larger, but narrower, cistern, when at first I was surprised to find that 2.25 times the weight was required to draw one of the boats through double the space, that was required to draw the other boat in the same time, thus 4.5 times the power was required to obtain double velocity in a narrow cistern.

The extra resistance I soon found was occasioned solely by the undue accumulation of water in front of the fastest boat, for on substituting narrower boats in the narrow cistern, a weight of 2⅛ was sufficient to produce double velocity of one boat in a narrow cistern, and on repeating the experiments in an open pond of water, where, by the use of lines upon drums of different diameters, supported upon elevated frames, so that the descent of the weights through one foot, drew

the boats through four feet, the extended results thus obtained, corresponded with those at first obtained in the wide cistern, namely, the descent of a double weight through a double space, caused the one boat to travel through twice the distance the other did, in the same time.

These experiments, then, prove alike, that quadruple power is required, and that quadruple power only is required to produce double velocity in a boat in open water, and also proves that double speed is twice as costly, and only twice as costly, as single speed, for an equal distance, in any vessel maintaining the same degree of immersion; because though four times the power is expended in a given time, yet the speed being doubled in that time, the actual power expended is but doubled also, because the quadruple expenditure of power is of only half the duration of the single expenditure.

The same results are obtained in another form, in the following experiments:—

A pair of paddle wheels were formed of tin plate, twelve and a half inches in diameter, on an iron axis two feet long, one half inch turned bearings to ditto, and a wooden drum, two inches diameter, thereon.

Each wheel (having sixteen floats, four inches long, by one and a half inches deep,) was immersed in water about two inches, and the wheels were then made to revolve by a cord, one end of which was wound on the drum, and the other end of the cord passed over a pulley suspended to the roof of a building.

When different weights were attached to the cord, the descent of each weight from the pully to the floor of the building, caused the paddle wheels to revolve a constant number of times, at different speeds, the times occupied by the different weights in their descent was ascertained by the oscillations of a pendulum.

Descent of weights during oscillations observed:

Of 2 lbs.,	67
4 lbs.,	+33
8 lbs.,	+16
16 lbs.,	+ 8

Thus in all those cases, double weights descending through double space, or quadruple power, caused the paddle wheels to revolve with double velocity in a uniform depth of water.

Could any farther evidence be required, that double velocity of a steam ship is acquired by the expenditure of quadruple power, it is to be found in the diagram of the Great Western steamer, vol. ii, page 274, of the American Repertory, and in the table and details thereof, pages 406 to 408 of the same volume, to which the writer has appended the following remark, and with a quotation thereof will conclude the present communication:—

"We ought to consider it a very fortunate circumstance that the steam engine has become its own commentator, we thus obtain certain facts unalloyed by prejudices or conceits, a concurrence as rare as valuable." I. F.

Brooklyn, N. Y., May 31st, 1842.

Remarks on Evaporation in, and Incrustation of, Steam Boilers.

Mr. C. W. Williams has read a paper before the Victoria Gallery, Manchester, upon the evaporation in, and incrustation of, boilers, in which he has endeavored to show that the destruction of the plates by the fire is not caused by the saline, or other permanent, incrustations, but by the muddy deposits which settle after the ebullition is over.

To prove this he exhibited experiments, showing that the incrustations were nearly as good conductors of heat as the metal of which the boilers are made, but that the muddy deposits are non conductors, and argues that as the incrustations will transmit the heat nearly as fast as the metal, that therefore they cannot cause its destruction. It does not appear that this conclusion is well founded, because although plates of iron, of usual thickness, will transmit the heat from the fire to the water as fast as generated, it does not follow that the same power exists when the plate is increased to an undue thickness. Suppose a boiler constructed of two or more plates, rivetted together—which would be a parallel case to a plate lined with one or more layers of incrustation—the effect would be, as is known from experience; to destroy the outer plate. What engineer has not seen the effect of a patch over the fire, when the internal plate has not been cut through, to admit the water to the inner surface of the new piece? We would scarcely advise engineers to depend upon the theory of Mr. Williams, in this particular, but to keep the boilers well freed from sediments of all kinds.

Mr. W. made some judicious remarks upon the necessity of keeping the plate always in close contact with water. He instanced a case where the water had been prevented from touching the plate by violent ebullition, and presented a sample taken from the water leg of the steamer Liverpool. The leg, though situated in the lower part of the boiler, between the furnaces, was so narrow that the heat from the adjacent fires drove the water entirely from between the plates, so that when an aperture was made steam only escaped. This is a fact of great importance, showing the necessity of making the passage, or leg, between the furnaces, of sufficient width to ensure a full supply of water. For the purpose of obtaining an enlarged grate surface, engineers are but too apt to contract the intermediate space and thereby incur a great risk of destruction to the leg sheets. It is, probably, one of the causes of the more rapid decay in the legs of our river and sea boats, than in any other part of the boiler.

The Liverpool's furnaces were four feet seven inches long, and five feet three inches deep; and the leg was a simple passage between them, probably not more than four inches wide, and when an intense fire existed, there was not sufficient space for the free circulation of the water. Four, or four and a half, inches, would have given ample space for the outer leg, to which the heat comes in contact only on one side; but the middle legs should not have been less than seven or eight inches in width.

Notice of Porter & Co.'s Patent Anchors.

Through the politeness of our London Correspondent, we have been favored with a copy of a pamphlet, issued by Porter & Co., of Dunston Iron Works, near *Newcastle-on-Tyne*, descriptive of the results of a number of practical tests to which their *patent anchors* have been subjected, by various officers of the Royal Navy, by pilots on the Coast of England, and by other mariners. From this pamphlet we shall extract the substance, for the information of our readers.

Few instruments now in use can justly lay claim to such high antiquity as the anchor; it clearly antedates the Christian era, and its origin is in fact so very ancient, as to be deeply involved in obscurity, though we believe its invention has usually been ascribed to the Tuscans.

The anchor, nearly in the same form as that in which it is at this day used, has been for ages employed; and although numerous attempts have, from time to time, been made to improve it, their practical success has not been great, and its general shape has remained almost unaltered; though within the last twenty years—since the general introduction of chain cables for shipping—it has been made shorter and stouter than formerly, whilst the stocks of chain anchors are usually made of iron, and so secured, by a forelock, that they can at pleasure be turned parallel to the shank, when the anchor is stowed inboard. On the other hand, when cables of hemp were more generally used, the stocks were fixed in their position, and formed of wood.

The year 1822 seems to have been prolific of inventions designed for the improvement of anchors—at least four distinct patents having passed the great seal of England, in that year, for various alterations in the form and mode of constructing them; of these, three had revolving flukes, and in one of the forms, patented by William Piper,* the flukes turn upon a bolt passing through the crown, as is the case with those we are about to describe, and, like them, the proper angle was to have been given to the entering fluke, by the revolution of the other, until its point, or bill, closed upon the shank, as in the *patent anchor* of Porter & Co.; (see fig. 3,) but as the latter is differently stocked—though identical in the principle of its fluke action—it is sufficiently distinct in form to be classed as a separate invention; besides, Porter & Co. have the merit (not, we believe possessed by the other,) of having brought their anchor into successful practical use, by freely submitting it to the test of actual experience at sea, under almost all the circumstances which commonly affect an anchorage: this test the anchor in question seems to have borne in a manner very satisfactory to the seamen by whom it was used.

Lieut. Rodgers, of the Royal Navy, and many other ingenious men, have at various times exerted their inventive talents in bringing forward new forms, or methods, of constructing anchors, but thus far without having superseded, to any great extent in practice, the ordinary form with which every one is familiar; whether the *patent anchor* of Porter & Co. will meet with the same fate as its predecessors, is a question which time and experience can alone determine; all that the latter yet justifies us in declaring is, that *it fairly promises*

* London Journal of Science and the Arts, (Newton's) vol. v, page 248.

to become a valuable substitute for the common anchor, especially in the naval service.

As it is unnecessary for our present purpose to enter into farther detail upon this subject, we will now proceed to speak more particularly of the *patent anchor* of Porter & Co., referring to their descriptive pamphlet as our text.

Fig. 1, represents the *patent anchor*, as it would probably rest upon the bottom, when first let go from a vessel.

Fig. 2, represents the position which the *patent anchor* would take at the first check it received from the cable.

Fig. 3, represents the position which the *patent anchor* would assume, in good holding ground, when fully strained by the cable.

We will here remark, in connexion with the illustrative cuts, that

the spurs, *e, e*, (fig. 2, &c.) seem indispensable to the successful action of the *patent anchor*, as without them, if the joint at the crown, *c*, should happen to be stiffened by rust, or any other cause, the anchor might readily slide along on the back of the fluke *d*, and come home without taking hold of the ground at all.

But it must be evident that this cannot happen when the spur *e* is attached to the fluke, for, from the weight of the anchor itself, as well as the shape of the toggle, or spur, it would immediately enter, or seize hold of, the ground; and the instant the cable was tightened, by the drift of the ship, the lower fluke would evidently revolve upon the spur *e*, as a pivot, and assume the position shown in fig. 2; *once in that position*, the bill of the lower fluke would enter, (if the ground admitted,) and a further draught upon the cable would bring the anchor into the position exhibited by fig. 3, in which it would remain, if the holding ground was good.

In all the illustrative cuts, the same letters refer to the same parts, and it may be well to remark, that the anchors represented are made wholly of *wrought iron*, forged in the best manner.

a, a, the stock; *b*, the shank; *c*, the crown; *d*, the flukes; *e*, the spurs, or toggles; *f*, the palms.

From documents quoted in the descriptive pamphlet of Porter & Co., it appears that a common anchor (on Pering's plan)—of the usual quality manufactured in the dockyards of the Royal Navy, for a first rate line of battle ship—and several of the *patent anchors*, were, in the presence of many distinguished officers, submitted, successively, to a breaking strain, by means of the powerful hydraulic proving machine, in Woolwich Dockyard. Of these trials of strength, the results are compiled in the following table.

Description of the anchor tried.	Weight of anchor in pounds.	Strain imposed in tons.	Deflection in inches at point of fluke.	Regular admiralty proof in tons.	Breaking weight of anchor in tons.	Ratio of weight of anchor to breaking weight.	Remarks.
1. Common anchor, of a 120 gun ship.	10847	60	$2\frac{3}{4}$	66	68	1-1 4	Steady pull.
		$66\frac{3}{4}$	$4\frac{1}{2}$				
		68	Unknown				
2. Porter's patent.	3136	14	Unknown	27	$60\frac{1}{2}$	1-43	Steady pull.
		20	$\frac{7}{8}$				
		$27\frac{1}{8}$	Unknown				
		$60\frac{1}{2}$	Unknown				
3. Porter's patent.	616	$20\frac{1}{2}$	Unknown	$8\frac{5}{8}$	$20\frac{1}{2}$	1-74	Steady pull.
4. Porter's patent.	560	$21\frac{1}{2}$	Unknown	$8\frac{1}{4}$	$21\frac{1}{2}$	1-86	Strain by jerks.
5. Porter's patent.	381	17	Unknown	$5\frac{3}{8}$	17	1-100	Steady pull.
6. Porter's patent.	620	27	Unknown	9	27	1-97	Steady pull.

It further appears, by our text, that Porter & Co.'s *patent anchors* have been more or less used in the Royal Navy for nearly three years, and that by order of the Lords Commissioners of the Admiralty, some *forty-five sail* of vessels belonging to the British navy, have recently been equipped with these *patent anchors*.

Previous to taking this step, however, the Admiralty, in the year 1841, pursuant to a request made of them by Porter & Co, caused

patent anchors (at the risk and expense of the patentees) to be simultaneously placed on board of some ten or twelve sail of her Majesty's cruisers, employed upon the coasts of England; and they instructed the commanders of these vessels to test the new anchors, in every possible manner, and report the results, *after three months actual service.*

The reports made under the orders alluded to, by these officers of the Royal Navy, concerning their anchorage with the *patent anchors,* in almost every kind of holding ground, *were uniformly favorable;* and to avoid repetition, we will here subjoin but three of these, (addressed by permission to the patentees,) viz: *one* from Commander Denham, R. N., and *two* from Mr. Thomas, a master in the navy, commanding H. M. surveying ship, the *Mastiff.*

Marine Surveyor's Department,
Port Fleetwood, Jan. 1, 1842.

Having had under trial, Porter's Patent Anchors, and subjected them to the most treacherous holding ground, great tidal jerks, and effect of eddies, as well as working round by steam paddle, *to foul them if I could;* I am now enabled to state that anchors so constructed will present to the mariner the combined essentials so long looked for. I need only enumerate the following:

It is almost impossible to foul it.

It bites quickly into the most stubborn ground.

It holds on to the shortest stay-peak.

It cannot well lodge on its stock end.

It presents no *upper* fluke to injure the vessel herself, or others, in shoal water.

It cannot injure vessels' bows when hanging a cock-bill, as merchant vessels find a convenient practice.

It is not so likely to break off an arm, or part in the shank, as anchors with fixed flukes do, because the construction of these arms can be of continuous rod iron, and the leverage is so much nearer the ring, owing to the pea of the upper fluke closing upon the shank.

It is a most convenient anchor for stowing in-board on a voyage, as the flukes can be easily separated, and passed into the hold; it can as easily be transported by *two* boats, when one would be distressed with the whole weight.

It produces the desired effect of ground tackle, at less weight.

Wishing it *general adoption,*
I remain yours truly,
H. M. Denham, Com. R. N., F. R. S.
Consulting Marine Surveyor.

Her Majesty's Surveying Ship "Mastiff,"
Woolwich, February 18, 1842.

Gentlemen—I received your letter of the 12th January, enclosing another from the Lords Commissioners of the Admiralty, authorizing me to give an opinion of the merits of your Patent Anchors, which have, by their sanction, been put on board her Majesty's ship under my command, for trial, between the year 1839 and the present

time; in order to do which, it will be necessary to detail all the circumstances attending them from the time they were embarked.

In 1839 your anchor, which was put on board, weighed only 8 cwt. 1 quarter, when the *Mastiff's* small bower anchor weighed 13 cwt.; with this discrepancy, added to a little prejudice in favor of our old forlorn hope, rendered me incapable of reasoning myself into the belief that your anchor was strong enough in the crown to hold the ship, or that it would bite the ground so quick as recent experience has taught me. Impressed with these ideas, and the ship being employed in a survey of the Orkney Islands, where she is compelled to anchor in narrow and intricate channels, in strong tides and eddies, surrounded by dangers, your anchor, gentlemen, was reserved for trying its merits in a wider space, where there was room to retreat in safety should it break: an opportunity offered of so doing on the 28th of November in the same year, when it was let go in 12 fathoms water, off Aldborough, with Orford Lighthouses in one; there was a fresh breeze, and considerable sea running at the time; by the time 29 fathoms of cable had been veered out, to our astonishment and agreeable surprise, the ship brought up and swung to the tide, when 60 fathoms of cable was given her; on the return of the weather tide, the ship was pitching her bows under water, and the wind had freshened, so much so, that with the force of forty men some difficulty was found to heave the ship a-head to stay a peak, yet this small anchor tenaciously held its gripe, until the topsails were filled, with the view of either breaking it or tearing it from its bed; we succeeded in doing the latter, and hove it up to the bows, not as we anticipated, with both flukes gone, but in good order, covered with mud and clay to the stock. This *first trial* did away with my former prejudice against it, and led me to apply for a larger anchor for trial; my application was met by you, gentlemen, putting on board, in the Frith of Forth, one of your Patent Anchors of 13 cwt., which was immediately taken to the bows, in lieu of one of the ship's bowers, and applied to use, the merits of which you will receive in my next letter.

I am, gentlemen, &c.
GEO. THOMAS, R. N.,
Master Commanding, and Marine Surveyor.

Her Majesty's Surveying Ship "Mastiff,"
Woolwich, February 23, 1842.

GENTLEMEN—Your Patent Anchor, weighing 13 cwt., which was received on board her Majesty's ship under my command, for trial, in April, 1820, was put into use the day it was embarked; it was let go in six fathoms water, off St. David's, in the Frith of Forth, and, by the time that 12 fathoms of cable was veered out, the ship was brought up, and the clasping of the upper fluke to the shank, was sensibly felt on board. At the expiration of three days an attempt was made to weigh it, but it had buried itself so deep in the mud, that, after heaving-to short a-peak, we were compelled to wait the rising of the tide to drag it from its bed; it was subsequently used until the month of November in the same year, in various parts of the Orkney Islands,

the ship anchoring every day on soils of mud, sand, stones, and a compound of the three; in no one instance did she drift or foul her anchor, nor was any precaution taken to prevent her so doing, but quite the reverse. Its unqualified merits and superiority, over all other anchors, was reported to the Lords Commissioners of the Admiralty. On our return to Woolwich, the above anchor was put on board her Majesty's ship *Albert,* at the request of Captain Trotter, to be used on her voyage to the Niger. In my next I shall relate to you, gentlemen, the merits of your Patent Anchor put on board this ship, for trial, in 1841.

I am, gentlemen, &c.
GEO. THOMAS, R. N.,
Master Commanding, and Marine Surveyor.

In addition to *sixteen* officers of the Royal Navy, as many masters of merchantmen, together with the pilots of the port of Deal, have all united to bear a favorable testimony to the valuable properties possessed by the anchors in question—all of these mariners having either ridden by them in their own vessels, or witnessed their successful holding in gales of wind, under a variety of circumstances. *The bulk of this evidence is, therefore, experimental.*

Porter & Co. have certainly brought forward a most forcible mass of important testimony in favor of their *patent anchors,* yet still there are a few objections, which may with propriety be urged against them.

Thus Captain John Washington, R. N, says:—"Were I to seek for objections, they would be, first, that the anchor supplied to the *Shearwater* was not easy to fish; this the patentee, by his recent improvement of placing a shackle on the lower part of the shank, has, I trust, completely remedied. Secondly, that in case of loss without a buoy-rope (which steamers never use,) it is very difficult to sweep. Thirdly, that letting go the anchor on a rocky bottom, it seems possible, *but improbable,* that the cheeks, or "lugs," of the shank, might strike a rock, and appearing the weaker part, snap; but this also has, I understand, been remedied."

To these objections we may add, that, from the testimony of Mr. Thomas, the commander of the *Mastiff,* given in the letters already quoted, it appears that under some circumstances, *these anchors hold too well.*

Some persons may smile at such an objection as this, but it must be recollected that *in the merchant service* the crews are usually small—that merchantmen cannot afford to leave their best bowers wherever it is necessary to anchor by them—that it is almost as requisite that an anchor should admit of being weighed with ease, as that it should hold well when down—in short, it seems that in cases like those stated by the Commander of the *Mastiff*—where he was obliged, in one instance, to fill his topsails for the purpose of loosening a small bower anchor (of Porter & Co.'s patent) from the ground, after heaving upon it in vain with *forty men;* and in another, after bringing the anchor short a-peak, * to await the rising of the tide, to break it out—

* That is, bringing the cable perpendicular from the anchor to the bows of the ship.

a merchant ship, *manned as usual,* would, probably, have been unable to get her anchor at all, on either of the occasions referred to. Now if this be not a real objection, we submit to those acquainted with nautical affairs, whether, at the least, *this very tenacious holding* will not sometimes be productive of great inconvenience.

Captain Washington's objection, that the *patent anchor "is very difficult to sweep,"* is a pretty strong one, for it is well known that many anchors have been recovered in this way, which would otherwise have been totally lost. The common anchor, when fixed in the bottom, has always one fluke projecting upwards; this affords great facilities in the operation of sweeping, which is generally so successful that it is actually followed as a business, by persons upon our seaboard, who may every summer be seen sweeping at random the exposed roadsteads along the Atlantic coasts, in which operation so many lost anchors are caught, as to make it frequently *a very profitable business:* a glance at Fig. 3, will show, that whenever the upper fluke has closed down upon the shank, an attempt to sweep the *patent anchor,* by the usual process with the bight of a hawser, *would be almost hopeless.*

Again it appears to us, that the additional surface exposed to oxidation by the *patent anchor,* at the junction of the shank and flukes, and the probable wearing and breaking of the fluke bolt at the crown from frequent use, are likely to be objectionable.

We must not, however, omit to notice—what the experiments above recited already prove—namely, that the *patent anchor* gains much strength from being in two separate pieces, as it admits of being forged in a compact and solid manner, and avoids the great practical difficulty in the common anchor of successfully welding the shank and flukes together, at the crown, *in such a manner as to be safe;* almost all the common anchors are unavoidably weak in this part, and it is a high merit in the *patent anchors* that, unlike the others, no practical objections exist to their being as well and solidly made as the material will admit.

In conclusion, we feel bound to observe, that the advantages promised by the *patent anchor*—as reported upon by the British naval officers—so far outweigh any objections which occur to us at this time, that we cordially recommend it to the consideration of our merchants—of the mariners in their service—*and, especially, we commend it to the attention of the superior officers of the navy of the United States.*

The Meteorological Table is omitted for want of room, but will appear in the next number.

JOURNAL

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AND

AMERICAN REPERTORY.

AUGUST, 1842.

Civil Engineering.

Facts and Observations on Four and Six Wheel Engines.
By JOHN HERAPATH, ESQ.

[CONTINUED FROM PAGE 20.]

Hull and Selby Railway.

By some means, the documents from which the following account is drawn, have for several weeks been overlooked.

After leaving the Manchester and Leeds Railway, I bent my course towards Hull. I have in another place, made a few observations on this railway, which, therefore, I have no necessity to repeat here.

Generally, this line is laid upon *kyanized longitudinal bearings,* but in one or two places there are cross-sleepers. The rails upon the longitudinal bearings are 44 lbs., but I did not learn what they were upon the cross-sleepers; I think about 70 or 75 lbs.

I asked Mr. Gray, the ingenious superintendent of the locomotives, how the kyanizing succeeded, and he told me he understood very well. I was anxious to know this, as I had upon another line heard some whispers against it.

I left Leeds on Monday, Nov. 29, for the purpose of proceeding to Hull, on the *Ariel* engine, which is fitted with Gray's patent expansive apparatus. This is an apparatus for cutting off the steam at almost any part of the stroke one desires, and changing that part at pleasure, by which means the engine may be adapted to almost any power required, and any velocity. Of this very ingenious invention, I shall say more hereafter, the inventor, Mr. John Gray—the gentleman before mentioned as the locomotive superintendent of the Hull and Selby line—having kindly presented me with a brass model to explain what my natural dulness did not permit me readily to comprehend,

when I was with him at Hull. Meanwhile I may mention, that there seems among the engineers to whom I have spoken about the invention, to be but one opinion as to its economical utility, and what has been not a little gratifying to my personal vanity, they have admitted that, though they were satisfied with the efficiency of the invention, they found great difficulty in learning its *modus operandi*, which proves that the heads of some of the engineers are as dull as mine.

The *Ariel* engine, I believe, belongs to the York and North Midland Company, and being made for a gauge of 4 feet 8½ inches, and, I think, rather loose in her axles, she appeared to be very unsteady, and twisted about much in going over that part of the North Midland Railway, from Leeds, which has a 4 feet 9 inch gauge, but afterwards she improved. Upon the *Ariel* I rode to the junction of the York and North Midland with the Leeds and Selby Railway, and then got upon the *Wellington*, of course a York and North Midland engine, as the Company leases the Leeds and Selby line. She was a very steady engine.

What this Leeds and Selby line was, I am unable to say, but it appears now to be a substantial and good line, having very nearly the character of the Hull and Selby Railway, which is a continuation of it; but if I recollect aright, for I did not take a note of it, the rails of the Leeds and Selby are laid upon stone blocks.

At Selby I got upon the *Liverpool*, one of the Hull and Selby Company's engines—another fitted with Gray's expansive apparatus.

Both the *Ariel* and the *Liverpool* were six wheel engines, and had 6 feet driving wheels, and 2 feet stroke, a proportion to which, Mr. Gray is, for some reason unknown to me, much attached; the former worked at 70 lbs. pressure, and the latter at 75. The *Liverpool* appeared to me to be a good engine, and performed well. I was informed that both she and the *Ariel* consumed but 18 lbs. of coke to the mile.

But to return to our engine and the driver; poor fellow, he had the misfortune to stammer, and had much difficulty, amid the noise of the air and engine, to make me understand him. However, if he had difficulty here, he was resolved to convince me that with Gray's apparatus, his engine had none of her motions. He flew along at a rapid rate, and as the road was so straight, and the engine a steady one, I considered my neck—to the safety of which I am rather attached—in no danger, and therefore enjoyed it very much.

This man spoke in the warmest terms of Gray's machinery, and, certainly, from what I saw him do with the engine, it manifested great capability. On my remarking, at one time, upon the power of the engine, he rejoined, "Yes, sir, and I can snap that coupling (that between the engine and the tender) at any time. Shall I do it now? I will if I shall." I have no doubt that he would, but as I imagined there might be a possibility at the same time of uncoupling me from the engine, and bringing me into closer contact with the ground, and perhaps with the wheel of the tender, than I had any anxiety for, I replied, "I am satisfied with your word, and have no wish to put you to the trouble of proving it."

The next day I went some distance up the line from Hull, upon the *Star* engine, with Mr. Gray, and returned upon the *Collingwood.* In returning upon the last engine, I observed she was unsteady, and inclined to pitch at low velocities, but lost it all at high. This, I have very little doubt, was owing to the position of the coupling link, as I have found it upon other lines.

This engine had a contrivance for lifting the trailing-wheels off the ground, for the purpose of giving more bite to the driving wheels; and it appears from a statement hereafter given by Mr. Gray, that this is applied to other engines of the Company, though but seldom used.

The average pressure of the steam in the engines worked by Mr. Gray's apparatus, appears to be about 75 lbs.

I was glad to see upon this line the third class passengers accommodated with seats, and to hear that the second class carriages are to have doors with glass panes in them.

The length of this line is 30¾ miles, and of the Leeds and Selby, 24¼. The passengers who go to York, do it in 51 miles, not including about 2 miles of ground which at present they have to travel over twice, for the purpose of going to a station and uniting with another train. To London from Hull, by railway, is 243 miles. Their rate of traveling by the mail on the Hull and Selby, is about 21 miles an hour, including stoppages.

The Company's stock of locomotives, in the middle of December, consisted of 12 engines, and two more nearly off the stocks, coupled in four wheels. Of this stock they have generally from eight to ten in an efficient state. In December they had nine. All their driving wheels have flanches. The average gross load during the first twelve months, including engine and tender, is stated to be 68 tons.

Two crank axles only have broken—one after running ten weeks, and the other at the Hull station. They were uncoupled, and of course both six wheel engines, (the Company have none else,) and the accidents happened in both cases at points from faulty axles, the welding being "about seven-eighths unsound." Not the slightest injury or inconvenience happened to any one. The engine in the second case had no load, and in the first, kept the rails and brought her train home.

There has been no instance of an engine running off the rails, or "anything like it."

The engines are all six wheel, and cost about £1,375; their extreme length is 19 feet 8 inches; height of centre of gravity supposed to be 4 feet, and in the smaller engines 3¾ feet; distance of extreme axles, 10 to 11 feet; height of middle of boiler, 5 feet 7 inches, and 6 feet; diameter of driving-wheels 5½ and 6 feet, of the other wheels 3½ feet, of cylinder 12 inches generally, one 14, and 2 coupled 16; stroke, some 18, some 24 inches. The average consumption of coke was 0.53 lbs. per ton per mile on the gross load, which by alterations was reduced to, 0.44, and with Mr. Gray's patent apparatus, to 0.32 lbs.; the corresponding gallons of water evaporated were 27½, 19⅓, and 15¾. The steam pressure is screwed down to from 60 to 80 lbs. I believe

the latter applies to the engines with Gray's expansive apparatus. The age of their best and worst engines is about 12 and 20 months. The total number of miles run in the first year was 135,000, or an average for each engine of 11,250, and expense per mile run 9d. Each running engine makes two double trips a day, or 124 miles.

With respect to the two kinds of engines, four and six wheel, and their peculiar motions, the following is an abstract of Mr. Gray's replies to the questions in my circular.

He prefers six wheel engines for economy of fuel, steadiness of motion, ease, durability, and less injury to the road. He says they have a little of each kind of motion, peculiar to locomotives, combined in their smaller engines, and less in their larger. With light pulling on straight lines, and especially descending, these motions are most conspicuous. The outside bearings of six wheel engines, he says, "undoubtedly give greater steadiness." He asserts that it is not the imperfections of the road which are the primary cause of the sinuous, pitching, or rolling motions, but that the sinuous "generates the rocking, and, in a slight degree, the pitching as well, however good the road may be;" that their "steadiest engines are their tallest, and this unusual result arises from great length in the front and hind axles." The springs are "rather longer, and a little more elastic (flexible) than usual." "The motions of our larger engines," he observes, "the nearer the centre of the axle the cranks are the better, but there being some other combining causes, it is difficult to say definitely what belongs to each."

The following summary, furnished me by Mr. Gray, will, at the same time that it developes his views on certain points, supply some interesting information not in the previous outline.

"Our engines have each six wheels, but six of them are prepared to lift the hind wheels from the rails, when a deficiency of adhesion is experienced; however, finding their pitching and serpentine motions considerably increased when upon four wheels, we never use them in that state with passenger trains, and but rarely with anything else. All their weight rests upon outside bearings.

"The other six are constantly six wheeled engines, (not being prepared to lift the hind wheels;) all the weight upon the front and hind shafts rests on outside bearings, and have, in consequence, the extensive base for the springs of eleven by six and a half feet, whilst they have inside bearings for the crank axle, and only two inside stay frames, steps, and springs, with all the weight on the crank resting inside of the wheels; thus the advantages of stability in six wheeled engines are secured, and also the chief merit of the London and Birmingham four wheeled engines, in a greater simplicity, and protection to the crank axle, is also obtained.

"The two coupled engines have outside bearings for the front axle, but only inside bearings for the crank and hind axles.

"The weight is 14¾ and 15¼ tons respectively; the weight of the coupled engines is not known yet. The weight of the driving wheels of the former is generally about seven tons.

"The first six engines have about 4¾ tons on the front axle, and the

other six about 6¼ tons, leaving for the former about three tons, and on the latter about two tons upon the hind axle.

J. Gray."

In a conversation I had with Mr. Gray, he said he thought four wheel engines would be as safe as six, if they were as long between the axles, and had outside bearings.

On this railway I had another opportunity of witnessing a similar accident to that which I witnessed on the Manchester and Leeds Railway. Tuesday morning, on my going to the station, I found the Liverpool engine—the one I had rode on the preceding afternoon—had come in, I think nineteen miles, tail first, with her left eccentric strap broken, by which means she had, of course, only her right cylinder to work with. Here, as in the case on the Manchester and Leeds, the flanches of the left wheels, both hind and fore, and the driving too a little, bore evident symptoms of having been much rubbed against the rails, while the right wheels' flanches had apparently not touched the rails. I pointed out this to Mr. Gray, and mentioned to him the very similar thing I had witnessed on the Manchester and Leeds Railway; but he seemed to think it was more due to the axles being out of square, than to the action of one cylinder; and after my return to town, he wrote to me, saying that he had had the axles measured diagonally, and found "they are a little out of square, inclining the engine to run to the same side where the flanches were observed to be most worn."

I readily present my readers with Mr. Gray's views upon this subject, at the same time begging to observe that I have not yet made up my mind, either from facts or scientific investigation, of what is the true explanation of the phenomena observed.

In the early part of this article I have hinted at some curious facts mentioned to me by Mr. Gray, *relative to longitudinal bearings and cross-sleepers.* The difference of draught in hoar frost and wet weather, Mr. Gray affirmed—and the affirmation was borne out by the testimony of one or two of their men, to whom I spoke on the subject—*was as much as* 50 *or more per cent. against longitudinal bearings,* the draught being so much greater upon them than it was upon cross sleepers. For instance, they assured me that oftentimes when the engine could with difficulty draw its load upon a level, over longitudinal bearings, it would trip up easily enough a rise, which they called their "bank,"of 14 or 16 feet a mile, in which the rails were laid upon cross-sleepers.

To me, at first, this was a poser, the solution of which I could not so much as guess at. Being, however, informed that the hoar frost seized the rails on the longitudinal bearings earlier, and left them much later, than it did those on cross-sleepers, I immediately divined the cause, and saw a beautiful, because an altogether unexpected, illustration of the truths of natural philosophy. It is known to philosophers, that before dew can be deposited on any body, this body must become colder than the atmosphere around it, and that hoar frost is nothing but dew, frozen by the temperature of the body on which it is, having sunk below the freezing point, that is, below 32° of Fahr.

It is also known, that the temperature of the earth, a little distance below the surface, is, at night, generally higher than that of the atmosphere. Wood is comparatively a non-conductor of heat. Therefore, and because the rails, where there are cross-sleepers, are imbedded in the ballast to within an inch or two of the top of the rail, and iron is a good conductor of heat, whatever heat the rails lose by radiation, on account of their rough surface, is quickly and wholly, or in a great measure, supplied from the sub-soil, where there are cross-sleepers, while it is not so where the rails are kept from a communication with the subjacent ground, by the broad and deep wood of the longitudinal bearings. The consequence is, that the rails on the longitudinal bearings lose more heat, and faster, and of course become colder earlier, and continue so longer, than those on cross-sleepers. Of course the deposited moisture from the atmosphere is earlier and more copiously condensed, and quicker and harder frozen, upon those than upon these. Hence the whole phenomena of heavier draught, arising from longer and greater slipperiness, upon the longitudinals, and, perhaps, at times of their being slippery when the cross-sleepers are wholly dry, and free from hoar frost.

As a confirmation of this, I may here mention what I observed Tuesday morning, Dec. 21st, upon the Bristol and Exeter Railway. It had been a calm and clear night, for the whole surface of the vegetable country was covered with a thick and hard hoar frost, which can take place in such circumstances only; and the stagnant water was everywhere covered with a thick coat of ice. The rails themselves were so covered with hoar frost, that we were obliged to have the assistance of a pilot engine; and yet with all the united power of two Great Western engines, our speed was comparatively slow. Being upon the platform of the engine, my attention was quickly caught by here and there perceiving patches on the rails, of one to one and a half feet, or perhaps more, perfectly dry and free from hoar frost, amidst the all but universal white which prevailed. Struck with the phenomenon, I looked more closely for something which might develop the cause, and soon saw that these exceptions to the hoar frost invariably appeared over the places where the longitudinal bearings abutted against each other. I called the attention of a relative of mine, who was upon the engine with me, to it, and we observed it for many miles together; so that I am quite satisfied it was owing to no local or accidental circumstance.

The explanation of this—which I call singular and important phenomenon, as bearing upon the relative advantages of two modes of constructing the upper works of railways—is simple and easy. The space between the ends of the longitudinal timbers is too small, and the timbers themselves too large, and maintain too high a temperature, for the hoar frost to affect the ground between them; the consequence is, during the still and clear night, heat is constantly communicated to the rail above by radiation, but chiefly, I apprehend, by the conduction of the atmosphere; by which means it is kept at a temperature that prevents the deposition of dew, and consequently the formation of hoar frost. This effect is of course not confined to a point, but

by the conducting power of the metal, diffused some little distance on each side the joining of the timbers.

Thus, if phenomena and circumstance were carefully attended to, many a lesson might be learned which would lead to improvement, and save hundreds of thousands in the construction of these costly undertakings. But to do it effectually, men must have courage to resist the allurements of comfortable carriages, and travel upon the engine—the only place where observations can efficiently be made—in all seasons and in all weathers. But our philosophising has carried us for the present too far from our friends on the Hull and Selby Railway.

Mr. Gray observed that frosty mornings were not the only times at which they found longitudinal bearings of much heavier draught than cross-sleepers. In wet weather it was the same, and the longitudinals much the heavier to travel over. As it had happened that rain to some extent had fallen, in the night preceding the morning on which we were out, we had an opportunity of witnessing the effect near one of the stations. A train was coming up, and we walked some little distance down to meet it. On its passing, I observed, even under the nail which fastened the rail to the timber, that water was expressed from between the timber and metal, as the engine passed, and re-absorbed the moment after. The same phenomenon, but in an inferior degree, occurred as the carriages passed. Hence, as Mr. Gray observed, "wherever the wheels are, in wet weather, it is a valley, and they are in the position of constantly ascending a hill," which of course much increases the draught.

In very dry weather, Mr. Gray does not think there is much difference between continuous bearings and cross-sleepers. From what I observed on the Midland Counties Railway, I am somewhat sceptical upon this. *I fear the draught is greater, under all circumstances, upon continuous bearings*, and, if I understand them rightly, I think Mr. Kearsley, the superintendent of the locomotives, and Mr. Woodhouse, the engineer of the Midland Counties Railway, are of the same opinion. It is, however, a matter well worth trying, and one which I should like much to put to the test of accurate experiment.

London and Birmingham Railway.

In my "Facts," &c., I omitted to mention that this Company have had nine detentions of trains, from defects of engines. In one case only was the detention nearly three hours; in another 2¾ hours; but the rest varied from about half an hour to about 1½ hour.

Railway Mag.

[To be continued.]

Mr. Vignoles' Lectures on Civil Engineering, at the London University College.

On Artificial Foundations.

Lecture I. Nov. 25th, 1841. After offering some comments on engineering generally, the lecturer alluded in particular to that impor-

tant portion where the skill of the engineer was most required—viz: foundations. After some instructive remarks upon the subject, he said that for the foundation of bridges, a network of timber had been used, and was found to be very good so long as it was under water; but if it were liable to become dry, and exposed to the effects of the atmosphere, it was sure to fail. He recommended concrete as far superior to timber; he had seen concrete forced into a quicksand, and no weight could afterwards force it out. Brick earth and clay form excellent foundations; the whole of St. Paul's, except the north-east corner, was built upon such a foundation, of from four to five feet thick; at the north-east corner, the architect being afraid to trust it to the ground, it being rather softer than the other parts, had the clay removed, and a well, of from twenty to 30 feet square, sunk to a depth of about 40 feet, where the hard bed was found. He then raised a solid mass of masonry to within nine or ten feet of the surface; arches were turned, and the foundation finished at an enormous expense; whereas. a few cubic yards of concrete would have answered equally well, if not better. All must have noticed the hole that was filled up in laying the concrete foundation of the Royal Exchange; there a few cubic yards of concrete did the work more expeditiously, and as well as the ingenuity of the mason could have effected it. He alluded to some of the most remarkable instances of the prodigality of architects in laying foundations, as the Barriére de l' Etoile (a triumphal arch at Paris,) where the cost of the foundation far exceeded the amount of surface work; and the viaduct of the Valley Floré, in which a mass of solid masonry, thirty feet thick, was erected, extending all across the valley. In these cases concrete would have answered the purpose equally well, and at an enormous reduction in expense. He stated that the leading principles he wished to impress upon the minds of the students, were extension of base and equality of surface. He then, at some length, explained the different foundations that had been used for bridge building, and mentioned particularly Ranger's patent for curing defects where foundations have given way, viz:—by using hot water to concrete applied in boxes, the hot water causing the concrete to expand. This was applied to the foundation of the Custom House when it had given way, in consequence of a failure in the piling. which rendered necessary the application of an artificial for a natural foundation. He then remarked upon the various methods now in vogue for keeping the piles of bridges dry while under repair, alluding to caissons, and Mr. Tierney Clark's method of putting in the foundation of the landing place at Gravesend by portable coffer-dams. The Professor concluded his instructive lecture, stating his wish to popularise the knowledge of engineering, as a means of benefiting the public at large.

Lecture II. Wednesday, Dec. 1st, 1841.—In the first lecture, Mr. Vignoles gave the general principles of the various descriptions of foundations; in the present, he proceeded to illustrate those principles by diagrams. He stated, that if a good foundation were provided by nature, the subsequent operations were simple, the main point being to imitate nature as closely as possible. Where the soil was bad, con-

siderable skill was required—for instance, in laying the foundation for the pier of a bridge, a wall, or a column, the first point was to give the base extensibility; in proportion as the natural soil was weak, so in equal proportion must the size of the base be increased; the pressure must also be equal—the soundness of the foundation not depending so much upon the amount of settlement as upon its equality. There were various ways of obtaining this, viz:—by the use of concrete alone, or in conjunction with timber, timber alone, or stone, or brick. Having so much insisted upon the necessity of an uniformity, it must be supposed that no portion of the artificial soil should escape; where that was likely, *sheet piling* must be resorted to. He then, by means of diagrams, explained the nature of the method, it being by driving piles close together, all round the foundation—the piles being (say) four inches thick, and as long as might be necessary. This method entirely prevented the escape of the soil in any manner but in a vertical direction, and ensured an uniform sinking, however bad the natural soil might have been. He then alluded to a very large chimney, twenty-two feet square, where the natural soil was a shifting quicksand; concrete was put in in layers, until the bed was eight feet thick; on this was placed a layer of flag-stones, five feet square. Eight days after the work was completed, the whole sunk eighteen inches, without the least deviation from the perpendicular. Other modes had been adopted, amongst which was the following: a number of timber balks were laid across, and concrete placed in the spaces between; then filled up with bricks: timbers were laid in a cross direction, and the flat stones placed upon them. In this instance the wood was laid where no change of atmosphere could affect it. The nature and use of a coffer dam was then explained, and the Professor, at some length, showed the danger of incautiously drawing the piles; the vacuity occasioned by their withdrawal being filled up by the surrounding matter, greatly injured the stability of the foundation. In making one of the London bridges, a great disfigurement had occurred in consequence of the incautious withdrawal of the piles, one side of the pier having sunk one foot. The modern plan to prevent such accidents, was to have a double coffer-dam, the piles of the inner one being cut off, when the outer piles might be withdrawn without danger. In laying foundations, he supposed there was a layer of soft ground, of moderate depth, with a hard substrata; piles must be driven through the soft soil, into the hard bed; a very slight depth would be sufficient, but still, in most cases, sheet piling would be necessary.

The Professor said that he was lately indebted to an officer of the Bengal Engineers, for an account of a very ingenious method, almost universally practised, in laying the foundations of temples and bridges in India. It would not answer here, labour being so dear; but there, where wood was very scarce, building materials in great plenty, and labor very cheap, it was the simplest and most effective that could be imagined. From the explanation, it appeared that the system was the same as piling, but, instead of using wood, small wells of brick-work were substituted. Take, for instance, the pier of a bridge; a

small well of brickwork was constructed—say six feet deep, seven feet in diameter, with a hole through it, three and a half feet in diameter; this is placed on the sandy bed where the foundation is to be made; a workman gets into it, and undermines the well from the inside, the earth being drawn up in buckets; additional layers are added to the top of the well, until a sound bottom was reached; and the singularity was, that there was not one or two of these little wells, but hundreds, and, in certain cases, to a depth of fifty-five feet; arches were then thrown across, and the superstructure raised. When the foundation was in the bed of a river, the excavation went on by the workmen diving through the water to the bottom of the well, and working there until obliged to come to the surface for air; for instance, through ten feet of water in the river, and to the extent of forty feet of water in the well—one of the most extraordinary instances of perseverance upon record. English engineers had somewhat abridged the labor, by substituting an oblong square of fifteen feet by four feet. with two elliptical holes for the workmen; so that, instead of three wells of six feet, they get one of fifteen feet—the principle being precisely the same.

In France, a number of bridges had been built where the water was not rapid, upon a very simple foundation—a framework of timber being made, furnished with short piles at the corner, and laid in the bed of the river, and the superstructure raised upon it, by means of a wooden diving-bell. The *pier perdue* was another way, but could only be used in still water; a quantity of stones were thrown in until a foundation was obtained; where there was any current, this foundation was sure to give way, as in Plymouth Breakwater and Kingston Harbor. He then alluded to the case of one of the London docks, where the wall, being made with too great a curve, from the want of pile sheeting, the soil gave way—the engineer adding fresh matter until the toe of the wall actually appeared (to the astonishment of all) above the surface on the other side. He then gave examples of several original methods of preparing for the formation of foundations in Italy and Ireland, by means of baskets of stones, &c.

Concrete.

The Professor next explained the nature of concrete, and gave directions for its formation, viz:—one part of lime, twice that quantity of sand, and twice as much broken stone, or gravel, as there was sand.

The goodness of the concrete depended upon the quality of the lime. In making concrete, it must be borne in mind that the materials were far more bulky separate than when mixed—for instance, to make a cubic yard of concrete, which contained twenty-seven cubic feet, it would be necessary to have thirty-four cubic feet of materials, besides the water. The three ingredients should be mixed dry, and the water added; in slaking, the concrete will expand about one-thirtieth in bulk.

The great expense of coffer-dams, and of piers generally, had lately led to a very peculiar construction of bridges by piling only, as, for instance, in iron bridges no masonry being used. The Professor

stated that he had built seven or eight bridges upon that system; the piles were driven in, and the iron work erected upon the wood. It had been tried to substitute cast iron for piles, instead of wood, but they had not succeeded, the iron being very liable to break. He also alluded to a beautiful arrangement for fixing branches to piles by means of a sliding collar, but which it is impossible to explain without diagrams. A French work, above two hundred years old was produced, with some very curious engravings of the modes then in use for securing foundations, and which proved that we are using the same means at present, and that many of our so-called new processes were in use at that time. He then concluded by stating, that at his next lecture he should bring forward some more general rules respecting foundations, and after that proceed to consider the best method of securing slopes of earth, now so generally in use.

Lecture III. Wednesday, Dec. 8th, 1841.—Mr. Vignoles explained that at his former lectures he had applied the term "concrete" too generally, and would now explain the difference between "*beton*" and "concrete." Beton was formed of the usual quantity of sand and gravel, broken stones, &c., but, instead of using the ordinary stone lime, hydraulic lime was applied. He then stated that beton is used exclusively under water, concrete only where water does not get in; beton never sets until it is under water, while concrete will not set except it is dry. The lime used for beton must be first slaked, while for concrete it slakes in the process of mixing. Beton sets best when let down gently in cases, and concrete when scattered from an eminence. Beton takes months to become hard, while concrete hardens in a few minutes. That both are in purport essentially the same—to form an artificial stone or rock—the one for works under water, and the other for those on land. He then alluded to the knowledge of the ancients of beton and concrete, and read extracts from the works of sundry authors, from Josephus to the present time, proving that assertion. The use of piles was also very ancient—the foundation of a brick pyramid, in Egypt, having been constructed on that principle. After impressing upon the minds of the students the great importance of a good foundation, and the efficacy of concrete for attaining that end, he concluded by stating that his next lecture would be again on the subject of foundations, and after that he would proceed to lecture upon slopes of earth, and explain the causes of the late accidents upon the different railways, pointing out where the errors of judgment had occurred.

Lecture IV. Wednesday, Dec. 15th, 1841.—Mr. Vignoles commenced by explaining the mode in which piles were driven it, and produced a model of a pile-driving machine (from the museum of the college,) by means of which, he showed the method in which steam power was applied to that machine, for expediting the work—stating, however, that, far from that application being a novelty, he had used it himself twelve or fourteen years ago.

Rock Foundations.

Having treated, in his former lectures, upon foundations in natural

soils, or various kinds of artificial bases, he would now notice such as were of the composite order, being partly on rock, and partly requiring artificial means to render them sufficiently sound for the required purpose. It often happens that, in making a bridge, there may be rock on both sides of the river, and the first pier may rest upon rock, while the second and third may have an insecure foundation, in consequence of a "pot-hole" (as it is called) of sand unexpectedly being discovered in the very spot where these piers are to be erected. The only plan to get over this difficulty is to cut the edge of the hole in steps; sheet-pile it a short space from the wall of the hole, and fill up the intervening space between the piling and the hole with beton, or some other substance, and thus form a continuation of the rock itself. Difficulties also present themselves in solid rock foundations—for instance, in such an erection as that of the Devil's Bridge. The ravine over which the bridge is to be thrown, may have been formed by the running of water; the strata accordingly runs with the usual inclination on both sides. If foundations for the piers of the bridge were not sunk deep enough into the rock, the press of the water filtering through the fissures of the strata, have such force, that, notwithstanding the resistance of the arch, he had known instances of the pier being actually pushed outwards. The only method of avoiding this, was to sink the pier so low into the rocks, and, by means of steps, secure it so firmly, that the force of the water must *break* the pier—not force it outwards—before it could destroy the bridge. The Professor, before going into the question of rock foundations, begged to state, that, in these lectures he only laid down the general principles of foundations; he could not go into the details of the business; and the circumstances of stone foundations were so varied, that it was only by a life of labor and experience that the best method could be arrived at. He wished that each student should, in his private study, well consider, and, by reading, test the correctness of the principles which he laid down for their guidance. A whole year's lecture, repeated every day, would be no more than sufficient to draw the attention of the student to important points—the details could only be gained by practical experience. In preparing the foundation of lighthouses, the whole resources of the engineer must be called into action. A lighthouse must be built in such a manner that it must actually grow from the rock. There are instances where lighthouses have fallen in a body; he could mention one in Ireland, the foundation of which was a solid rock; he saw a party who witnessed its fall, and who informed him that it fell in a solid mass, tearing away a portion of the rock with it. The fault was, that the foundation was not sunk deep enough into the rock. He then alluded to the celebrated Pharos (of Pharos) of Alexander, which was justly reckoned one of the seven wonders of the world; it was built about 283 years B. C., and received its name from the island on which it was built; it was 550 feet high, and the base was 150 feet square, and could be seen at a distance of forty English miles. Josephus, and many other authors, had given descriptions of it, which pretty well agreed; and what was most extraordinary, that the very same method of making the foun-

dation was practised then as now. The stones were dovetailed together, doweled, and run with lead—so as to firmly secure them in their places. The cost of the building amounted to no less a sum than £200,000 of our money, and it lasted above sixteen centuries. No diminution in its height occurred until after 1000 years from its erection, at which time about one-third of its height was wasted away by time; and it was only within about 400 years that the whole is supposed to have been destroyed, and that only by means of an earthquake. He then remarked, that it was very seldom that the name of an engineer was handed down for 2000 years, but all accounts agreed that Sosastros was the name of the engineer who erected this wonder of the world. The celebrated Corduan, or, as it is generally called, Cordovan, Lighthouse, at the mouth of the Garron, is built upon the same principles as the Pharos; this lighthouse is, however, circular, but the masonry is not calculated for durability—it being built of freestone. The expense of this lighthouse was enormous, as must be supposed when millions of francs were expended upon ornament, which was the more absurd when it was considered that it stood upon a barren rock, in the middle of the sea. He could not help quoting a line of Pope—

"'Tis only usefulness that sanctifies expense."

This is a sentiment that he wished to impress upon the minds of all his students, for it was a great fault of modern engineers to expend great sums upon ornament, which could be far better employed upon actual necessaries. He then turned to the Eddystone Lighthouse, and related the histories and fates of the two lighthouses preceding the one now standing, which was erected by the genius of Smeaton, and strongly recommended his pupils to read the account published of that great work. The Eddystone rock is peculiarly interesting to the engineer; it is found first at about one mile deep in the ocean, and then rises gradually about one foot in ten, until it reaches near the level of the sea, when a sudden crop makes its appearance, and rises above the surface. From the peculiar formation of this rock, there is always a heavy run upon it, which renders it so very dangerous. The learned Professor, after explaining at some length the process of the erection of this celebrated lighthouse, concluded his lecture. Mining Jour.

(To be continued.)

Davies' Elliptograph.

Mechanical draughtsmen have long required the assistance of some simple instrument which should, without any previous complicated adjustment, enable them at once to strike the ellipses, which would correctly represent the perspective of wheels and other circles.

Such an instrument has been designed by Mr. Henry Davies, already well known as the author of several other useful and highly important inventions, and we have much pleasure in adding to the list, that which is represented in the following engraving.

This ingenious little instrument consists of an upright stem, or axis,

which terminates at its lower end in two points, *a*, *a*, to give it the required stability in a perfectly vertical position. On the upper part of this axis a compass head, *b*, revolves, having attached to it, by a joint at *c*, the pen, or compass limb, *c*, *d*. A square, horizontal shaft is jointed into the latter at *e*, and maintained in its position by the parallel rod, *f*. Upon the central shaft, or axis, *a*, there is pivoted a circular steel plate with beveled edges, *g*, which may be set at any required angle to the horizon by the quadrant and set screw, *h*. A T-shaped guide, *i*, has its longer stem, *k*, passed through the horizontal shaft, and held by the set screw, *m*. The face of the guide, *i*, is constantly kept in close contact with the edge of the circular disk, *g*, by means of a small spring, *l*.

A glance at this arrangement will almost suffice to show its operation. Suppose, in the first place, that the disk *i* is set perfectly hori-

zontal, and the instrument applied to describe a figure upon paper; on turning round the compass limb and pen, *c*, *d*, a transcript of the disk, *g*, that is a circle, will be delineated, because the pen has been guided round in a circular path, by the spring *l*. Let the disk *g* be now set at any angle, say 45°, and the instrument applied to paper and turned round; the pen will again be guided round the disk *g*, but no longer in a circular path; an ellipse will be described, which will be the correct perspective of a wheel or circle, viewed at an angle of 45°; and so of circles viewed at any other angles, of a size within the powers of the instrument.

The set screw, *m*, allows the compass to be set to the size of the circle required; at the same time the guide, *i*, is always maintained in contact with the disk.

We hope and trust that this convenient and ingenious little instrument will be speedily brought before the public, in a form, and at a price, that will enable all parties to avail themselves of its important advantages. Mech. Mag.

Description of the Bann Reservoirs, County Down, Ireland. By John Frederick Bateman, *M. Inst. C. E.*

The situation fixed upon for the reservoir, rendered necessary the construction of four embankments between the hills, so as to raise the water to a height of 35 feet above the summer level of the lake.

These embankments were all constructed in a similar manner, only varying in the slopes and thickness of the stone facing, according to the extent and situation.

The whole substratum of the valley was water-tight, either from the existence of the solid rock, dense clay, or of hard, compact, mountain gravel; so that there was no difficulty in securing the foot of the puddle. A trench was sunk into the water-tight stratum, whence the vertical puddle wall was carried up with the bank to the required height. It was twelve feet in width at forty feet below the top, diminishing gradually to eight feet wide at the summit, and was worked in regular layers of eight inches in thickness.

The embankments were formed in concave layers, three feet thick —each layer being completed before another was commenced—steps being cut in the ground where necessary, to receive the layers.

In order further to secure the tightness of the bank, a lining of peat, fifteen inches in thickness, was brought up on the inside of the puddle, and a layer of the same material was laid upon the face of the slope; it was cut small, placed in thin courses like the puddle, and merely trodden down without more moisture than it naturally contained. The author advocates the use of peat in such positions, as from its light and fibrous nature, in case of a leak occurring, the draught would attract into it all the fibrous particles, which by degrees would stop the holes sufficiently for the silt to settle over, and effectually close, the aperture.

Above the peat, a course of gravel, three feet in thickness, was laid, and upon that the stone pitching, forming the inner side of the bank.

The inner slopes were, for twenty feet below the top of the bank, two and a half horizontal to one vertical; the outer were two horizontal to one vertical; where they were deeper than twenty feet, the remainder of the banks sloped three to one on the inside, and two and a half to one on the outside.

All the embankments are twelve feet wide at the top, and five feet above the water level.

The centre of the deepest part of the embankment was traversed by a stone culvert, in which were placed two rows of cast-iron discharge pipes, eighteen inches diameter, with suitable valves. A leak was discovered in the centre of the masonry of this culvert, occasioned by the engineer's instructions not being obeyed. The details of the methods employed for remedying this defect, are given at length, as also those of the experiments upon cements made by the author after the data given by Vicat. The materials which were most accessible for the work, were tested very carefully, and from the results, it was determined to employ mortar composed of rich Manx, or mountain lime, carefully slaked, and clay burned with peat in the open air. The proportions were two and a half of clay to one of lime. They were ground together, and being mixed with as much water as was necessary, the mortar was used immediately. The mortar for the backing had one measure of sand added; the grout had two measures of sand in it, and was used thin.

The concrete was composed of one part of lime, two and a half of calcined clay, and about three parts of sharp gravel.

This cement appeared to set hard, and to be perfectly tight; but when the reservoir was partially filled, several leaks were discovered, which rendered an examination necessary, and some energetic measures were taken to stop them, all which are described.

The result of the author's experience seems to be, that mortar made from rich lime and calcined clay, as recommended by Vicat, may set and harden under water, when there is little pressure, but that it is not able to resist the pressure of a considerable depth of water. *

The details of the construction of the masonry of the valve house, the fore bay, the waste weir, the bridge of three arches, constructed over the feeder from the river Muddock, and the various feeders for supplying the reservoir, are given at length, with the particulars of the expenditure of the sum of £14,891, which was the cost of the work, exclusive of land compensation, or salaries and professional charges.—*Proceed. of Instit. of Civ. Eng.* Civ. Eng. & Arch. Jour.

* Colonel (now Major General) Pasley, of the Royal British Engineers, in his admirable work on Cements, &c., having clearly proved that *a factitious water cement can be made from chalk-lime, and blue clay*, which will equal *the best natural cements* of England, we must ascribe this partial failure to some defect in the process of M. Vicat—which, it must be remembered, has received the censure both of General Treussart and Colonel Pasley, the best writers upon the subject of *water cements.* M.

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. Dumas.

[CONTINUED FROM PAGE 28.]

II. Since [the causes of] all the phenomena of life are exerted upon matters which have for their base carbon, hydrogen, azote, oxygen; since these matters pass over from the animal kingdom to the vegetable kingdom, by intermediary forms, carbonic acid, water, and the oxide of ammonium; lastly, since air is the source whence the vegetable kingdom is fed, and the reservoir in which the animal kingdom is annihilated—we are led to take a rapid survey of these different bodies with a special view to general physiology.

Composition of Water.

Water is incessantly formed and decomposed in animals and plants; to appreciate what results from this, let us first see how it is composed. Some experiments founded on the direct combustion of hydrogen, and in which I have produced more than two pounds of artificial water—experiments which are in truth very difficult and very delicate, but in which any errors would be unimportant with regard to the circumstances which we are engaged upon—make it very probable that water is formed, in weight, of 1 part hydrogen, and 8 parts oxygen, and that these whole and simple numbers express the true relation according to which these two elements combine to form water.

As substances always present themselves to the eyes of the chemist by molecules, as he always endeavors to connect in his thoughts, with the name of each substance, the weight of the molecule, the simplicity of this relation is not unimportant.

In fact, each molecule of water being formed of one molecule of hydrogen, and one molecule of oxygen, we arrive at these simple numbers, which cannot be forgotten.

A molecule of hydrogen weighs 1; a molecule of oxygen weighs 8; and a molecule of water weighs 9.

Composition of Carbonic Acid.

Carbonic acid keeps incessantly forming in animals, and is continually undergoing decomposition in plants; its composition, therefore, deserves a special notice in its turn.

Now, carbonic acid, like water, is represented by the most simple numbers. Experiments founded on the direct combustion of the diamond, and on its conversion into carbonic acid, have proved to me that this acid is formed of the combination of 6 parts by weight of carbon, and 16 parts by weight of oxygen.

We are, therefore, led to represent carbonic acid as being formed of one molecule of carbon weighing 6, and two molecules of oxygen

weighing 16, which constitute one molecule of carbonic acid weighing 22.

Composition of Ammonia.

Lastly, ammonia, in its turn, seems formed in whole numbers of 3 parts of hydrogen and 14 of azote, which may be represented by 3 molecules of hydrogen weighing 3, and by one molecule of azote weighing 14.

Thus, as if the better to show all her power, Nature operates, in the business of organization, upon a very small number only of elements, combined in the most simple proportions.

The atomic system of the physiologist revolves on these four numbers—1, 6, 7, 8. 1 is the molecule of hydrogen; 6 that of carbon; 7, or twice 7, i. e. 14, that of azote; 8 that of oxygen.

These numbers should always be associated with these names, because for the chemist there can exist no abstract hydrogen, nor carbon, nor azote, nor oxygen. They are beings in their reality which he has always in view; it is of their molecules that he always speaks; and to him the word hydrogen depicts a molecule which weighs 1; the word carbon, a molecule which weighs 6; and the word oxygen, a molecule which weighs 8.

Composition of the Air.

Does atmospheric air, which performs so great a part in organic nature, also possess as simple a composition as water, carbonic acid, and ammonia? This is the question which M. Boussingault and I have recently been studying. Now we have found that, as the greater number of chemists have thought, and contrary to the opinion of Dr. Prout, to whom chemistry owes so many ingenious views, air is a mixture, a true mixture.

In weight, air contains 2,300 of oxygen for 7,700 of azote; in volume, 208 of the first for 792 of the second. The air, besides, contains from 4 to 6 10,000ths of carbonic acid in volume, whether it be taken at Paris or in the country. Ordinarily, it contains 4 10,000ths. Moreover, it contains a nearly equal quantity of the carburetted hydrogen gas, which is called marsh gas, and which stagnant waters disengage perpetually.

We do not speak of aqueous vapor, which is so variable; of oxide of ammonium and of nitric acid, which can only have a momentary existence in the air, because of their solubility in water.

The air, then, is constituted of a mixture of oxygen, azote, carbonic acid, and marsh gas.

The carbonic acid in it varies, and indeed greatly, since the differences in it extend almost from the simple to the double, from 4 to 6 10,000ths. May this not be a proof that plants take from the air this carbonic acid, and that animals take back a part from it? In a word, may not this be a proof of that equilibrium of the elements of the air attributed to the inverse actions which animals and plants produce upon it?

It has, indeed, been long since remarked, that animals borrow from the air its oxygen, and give to it carbonic acid; plants, in their turn,

decompose this carbonic acid, it order to fix its carbon, and restore its oxygen to the air.

As animals breathe continually; as plants breathe under the solar influence only; as in winter the earth is stript, whilst in summer it is covered with verdure—it has been supposed that the air must transfer all these influences into its constitution.

Carbonic acid should augment by night, and diminish by day. Oxygen, in its turn, should follow an inverse progress.

Carbonic acid should also follow the course of the seasons, and oxygen obey the same law.

All this is true, without doubt, and quite perceptible as to a portion of air limited and confined under a jar; but, in the mass of the atmosphere, all these local variations blend and disappear. Accumulated centuries are requisite in order effectually to put in action this balance of the two kingdoms, with regard to the composition of air; we are then, very far from those daily or yearly variations, which we had been apt to look upon as being as easy to observe as to foresee. With regard to oxygen, calculation shows that, exaggerating all the data, not less than 800,000 years would be required for the animals living on the surface of the earth to consume it entirely.

Consequently, if we suppose that an analysis of the air had been made in 1800, and that during the entire century plants had ceased to perform their functions on the surface of the whole globe, the animals at the same time all continuing to live, the analysts in 1900 would find the oxygen of the air diminished by 1-8000th of its weight—a quantity which is beyond the reach of our most delicate methods of observation, and which, assuredly, would have no influence whatever on the life of animals or plants.

As to this, then, we cannot be deceived; the oxygen of the air is consumed by animals, who convert it into water and carbonic acid; it is restored by plants, which decompose these two bodies.

But nature has arranged everything so that the store of air should be such, with relation to the consumption of animals, that the want of the intervention of plants for the purification of the air, should not be felt until centuries have elapsed.

The air which surrounds us weighs as much as 581,000 cubic kilometres of copper; its oxygen weighs as much as 134,000 of these same cubes. Supposing the earth peopled with a thousand millions of men, and estimating the animal population at a quantity equivalent to three thousand millions of men, we should find that these quantities united consume in a century only a weight of oxygen equal to 15 or 16 cubic kilometres of copper, whilst the air contains 134,000 of it. It would require 10,000 years for all these men to produce a perceptible effect upon the eudiometer of Volta, even supposing vegetable life annihilated during all this time.

In regard to the permanence of the composition of air, we may say with all confidence, that the proportion of oxygen which it contains is secured for many centuries, even reckoning for nothing the influence of vegetables, and that nevertheless, these restore oxygen to it incessantly, in quantity at least equal to that it loses, and perhaps

more—for vegetables live just as much at the expense of the carbonic acid furnished by volcanoes, as at the expense of the carbonic acid furnished by animals themselves. It is not then for the purpose of purifying the air that these breathe, that vegetables are especially necessary to animals; it is, above all, to furnish them incessantly with organic matter quite ready for assimilation—organic matter which they may turn to their advantage.

There is, therefore, a service necessary, without doubt—but so remote, that it can scarcely be recognised—which vegetables render us, in purifying the air which we consume. There is another service, so immediate, that if, during a single year, it were to fail us, the earth would be depopulated; it is that which these same vegetables render us by preparing our nutriment, and that of all the animal kingdom. In this, especially, is found, the chain that binds together the two kingdoms. Annihilate plants, and the animals all perish of a dreadful famine; organic nature itself entirely disappears with them in a few seasons.

We have, however, said that the carbonic acid of the air varies from 4 to 6 10,000ths. These variations are very frequent, and very easy to observe. Is not this a phenomenon reproaching the influence of animals who introduce this acid into the air, and that of vegetables which deprive it of it?

No; this phenomenon, you are aware, is a simple meteorological phenomenon. It is with carbonic acid as with aqueous vapor, which forms on the surface of the sea, to become condensed elsewhere, fall again in rain, and be reproduced under the form of vapor. This water, which is condensed and falls, dissolves, and carries with it carbonic acid; this water, which evaporates, yields up the same gas to the air.

A great meteorological interest would attach to the observation of the variations of the hygrometer, and those of the seasons, or of the state of the sky with the variations of the carbonic acid of the air; but hitherto all tends to show that these rapid variations constitute a simple meteorological event, and not, as had been thought, a physiological event, which, singly considered, would infallibly produce variations infinitely slower than those which are, in fact, observed as much in towns as in the country itself.

Thus the air is an immense reservoir, whence plants may for a long time derive all the carbonic acid necessary for their wants; where animals, during a much longer time still, will find all the oxygen that they can consume. It is also from the atmosphere that plants derive their azote, whether directly or indirectly: it is there that animals finally restore it.

The atmosphere is, therefore, a mixture which unceasingly receives and supplies oxygen, azote or carbonic acid, by means of a thousand exchanges, of which it is now easy to form a just idea, and the details of which a rapid analysis will now enable us to appreciate.

Gardener's Mag.

[TO BE CONTINUED.]

Hourly Meteorological Observations during the Equinoxial periods from December, 1840, *to March,* 1842; *made at the University of Nashville, Tennessee, in North Latitude* 36° 09′ 33″, *W. Long.* 86° 49′ 03″, *by* James Hamilton, *Prof. Math. and Nat. Phil.*

The position of the instruments is the same as reported heretofore. The only change of instruments is the substitution of Jones' Improved Englefield Barometer, in place of the old English Barometer. As I have not reduced the observations, it is proper to add that the cup is one inch in diameter, and one inch in depth. The tube is about one-tenth of an inch in diameter, and is marked 53.

December 21, 1840.

Hour.	Ex. Ther.	At. Ther.	Bar.	Weather.	Wind. dir.	Wind. force.	Remarks.
	deg.	deg.	in.				
6 A. M.	21	33.5	29.780	Clear.	W. / N.E.	0	
7	21	33.5	29.782	do.	do.	0	Light clouds in horizon and
8	22.5	33.5	29.784	do.	do.	0	some fog.
9	29	35	29.782	½ Clear.	do.	0	Fog denser. Cinostratus.
10	34	35	29.788	do.	S. of W. / N.E.	1	Cinostratus.
11	37	36	29.754	¾ Clear.	S.W. / N.E.	1	Cinus.
12	39	36.5	29.724	do.	do.	1	Cinostratus. Dew pt. 20.25°.
1 P. M.	41.5	37.5	29.696	do.	do.	1	do.
2	43.5	37	29.678	Clear.	do.	1	
3	43.5	37	29.662	do.	do.	2	No clouds, but hazy near horizon Dew pt. 24°.
4	41	37	29.646	do.	S.W. / E.	2	No clouds.
5	38	37	29.637	do.	S.E.	2	Stratum of clouds in West, and hazy in the East.
6	35.5	37	29.632	do.	do.	1	
7	34.5	37	29.624	do.	do.	1	West, stratum rising.
8	37	38	29.624	Cloudy.	do.	1	Sky covered with clouds.
9	38	38	29.638	do.	do.	1	Do. Dew pt. 28.
10	39	38	29.639	do.	do.	0	Do.
11	39	39	29.640	do.	do.	0	Do.
12	39	39	29.640	do.	do.	0	Do.

Minimum of Thermometer during night, . 39°

Morning of Dec. 22nd Wind N. E., but clear.

March 22, 1841.

Minimum during the night, ... 56.5°.

6 A. M.	61.5	62	29.182	½ Clear.	S.W.	2	Cirrus above and Cumulus below. Sun rises above thick cl'ds; shines dimly at 6h 50m.
7	61.5	62	29.182	do.	do.	2	
8	65	62.5	29.170	¼ Clear.	do.	3	Clouds thicken at 9h. 50m.
9	69	63	29.169	do.	do.	3	Wind 5.
10	71	64	29.126	do.	do.	4	
11	73	64.5	29.100	¾ Clear.	do.	4	Sun shines.
11½	Clouds more dense.						
12	76	65	29.050	do.	do.	3	
1 P. M.	77	66	28.990	Clear.	do.	3	
2	77	67	28.940	½ Clear.	do.	4	Clouding again.

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
3 P. M.	77	67	28.918	Clear.	S.W.	4	Dew point 56°.
4	75	67	28.900	Cloudy.	do.	5	
5	71	67	28.886	do.	do.	5	
6	69	67	28.880	r.	do.	4	Rain moderate.
7	66	67	28.871	do.	do.	1	Do.
8	62	66	28.866	R.	S.W.	2	Rain became heavy at 7h. 56m.
9	66	60	28.858	r.	do.	1	
10	60	66	28.850	r.	do.	2	
11	59	66	28.850	R.	S.W.by W.	7	Storm violent.
12	52	64	28.900	c.	W.	4	Begins to clear.

Minimum of Thermometer during night, . . 37°.

March 23—Barometer 29.210 N.W. Clear.

June 21, 1841.

Not observed more than other days.

9 A. M.	84	83	28.758	Clear.	S.W.	2	
Noon.	89	83	28.754	½ Clear.	do.	2	
3 P. M.	92	84	28.700	c.	do.	3	Dew point 66°.

Minimum of Thermometer, 69°. Thunder storms on 20th and 22nd.

September 21, 1841.

Minimum 65°.

6 A. M.	68	73	28.925	Cloudy.	S.W.	3	
7	69	73	28.922	do.	do.	3	A little rain fm. 7h. 50m to 8h. 05.
8	70.5	73.5	28.918	r.	do.	3	
9	75	74	28.904	c.	do.	4	
10	77	74.5	28.892	c.	do.	3	
11	75	74	28.892	r.	do.	3	
12	76.5	74.5	28.882	r.	do.	5	
1 P. M.	77	74.5	28.810	c.	do.	5	
2	76	74.5	28.808	r.	do.	2	Rain heavy from 2h. to 2½h.
3	76	75	28.810	c.	do.	2	Dew point 64°.
4	77	75	28.810	c.	do.	2	
5	74	75	28.818	c.	do.	1	
6	71	74.5	28.818	c.	do.	1	Signs of clearing.
7	69	74.5	28.812	c.	S.W.by W.	0	Lightens in S.
8	68	74	28.812	c.	do.	0	Do. Clouds in W.
9	68	74	28.816	c.	do.	0	Lightens in W. Clouds increase.
10	65	74	28.820	r.	W.	3	Th. Storm at 9h. 40m.
11	63	73	28.826	c.	W.	1	Clearing.
12	62	73	20.826	c.	W.	1	Do.

Minimum during night . . 58°.

September 22—Cloudy, but wind from West. Barometer at 9 A. M. 28.836.
Amount of rain 24-100 inch.

December 21, 1841.

Minimum of Thermometer, . . 41°.

6 A. M.	41	47	29.442	c.	S.W. / N.E.	2	Amount of rain on 20th, .70 inch.
7	41	47	29.450	do.	do.	1	
8	41	47.5	29.500	do.	do.	2	Clouds break in N.
9	41.5	47.5	29.534	do.	do.	3	
10	43	47.5	29,544	do.	do.	3	Clouds light in N.; heavy in S.
11	45	47.5	29.544	do.	do.	3	Do.
12	46	47.5	29.506	do.	do.	3	Do. Dew point 21°.
1 P. M.	47	47.5	29.500	do.	do.	3	
2	47.5	47.5	29.496	do.	S.W. / E.	3	Almost clear in N.
3	46	47.5	29.490	do.	E.	3	

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
4 P. M.	45	47.5	29.502	c.	E.	2	
5	45	47.5	29.500	do.	do.	2	
6	45	47.5	29.498	do.	do.	2	
7th, 8th, and 9th hours, no change.							
10	45	47	29.498	do.	do.	0	
11	45	46	29.486	do.	do.	0	
12	45	46	29.484	do.	do.	0	

December 22—Min. 44°. Bar. 29.418 at 9 A. M.

Amount of rain on 21st = .08; on 22nd = .72.

March 21, 1842.

Minimum of Thermometer, . . 65°.

6 A. M.	67	71	29.050	c.	W.	3	
7	68.5	71	29.072	c.	do.	3	
8	69.5	71	29.080	c.	do.	3	
9	68.5	71	29.100	c.	do.	3	
10	72	71.5	29.084	c.	do.	3	
11	73	71.5	29.086	c.	do.	3	
12	76	72	29.052	Clear.	do.	3	Clouds only in S. Dew pt. 55°.
1 P. M.	77	72	29.020	do.	do.	2	Wind rises at 1½ P. M.
2	78	72.5	28.996	do.	do.	5	
3	79	72.5	28.984	do.	do.	5	
4	79	72.5	28.980	do.	do.	5	
5	78	73	28.976	do.	do.	5	
6	74	73	28.986	do.	do.	4	
7	73	73	28.990	do.	do.	2	Cumuli in N.
8	71	73	28.992	do.	do.	1	
9	70	73	29.020	do.	do.	1	
10	69	72.5	29.038	½ Clear.	do.	2	A few thin clouds.
11	67.5	72.5	29.054	Clear.	do.	2	
12	66	72	29.060	do.	N.	0	

March 22—Min. of Ther. 48°. Bar. 29.196 at 9 A. M. Wind N. E., but clear.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A Comparison of the Mean Temperature of the Year with the Mean Temperature of October and April. *By* C. B. Hayden.

Pouillet, in the meteorological portion of his Eléméns de Physique, &c., announces as a general law the close approximation of the mean temperature of October to that of the year, and asserts that the former may be regarded as a substitute for the latter, and quotes, in illustration, a table from one of Humboldt's Meteorological Memoirs, which sufficiently confirms the law for the contained localities. To ascertain how far this law was applicable to the United States, the accompanying table was compiled from data furnished by the North American Almanac, Army Register, and such other sources as were most readily accessible. This table includes localities from a wide area of country, presenting a great variety of climate, not only as dependent upon latitude, but upon literal and inland situation. The * in the table indicate that for the localities to which they are annexed, the mean temperature of April is nearer that of the year than the mean temperature of October; and as this number amounts to forty-one, out of seventy, localities, or about fifty-nine per cent., it shows an important variation of the above-mentioned law, in refer-

ence to the United States. The closer approximation of the mean temperature of April to that of the year, seems to be general, not only for the more uniform climate of the coast and great lakes, but the more excessive climate of the interior, as well as for the northern and southern portions of the Union—though the exceptions in favor of October are most numerous in the middle and southern States. As a general rule, the mean of October is *higher* than that of April, and both are *lower* than the mean of the year in the United States.

Localities.	Mean of Year.	Mean of October.	Mean of April.	Series of Obs. years.	Observers.
Baltimore *	52.94	54.87	52.12	8	L. Brantz.
Salem *	48.86	51.34	46.62	43	D. Holyoke.
Medfield *	46.48	50.11	43.18	12	D. C. Sanders.
Eastport *	41.75	46.08	39.50	2	
Burlington	43.60	47.70	39.40	1	
Albany *	44.73	42.32	42.71	1	
Auburn, N. Y. *	44.75	40.71	41.77	1	
Canandaigua, N. Y.	43.78	42.42	51.44	1	
Cherry Valley,* "	41.25	37.91	40,72	1	
Clinton "	46.92	48,89	42.83	1	
Cortland * "	42.04	38.43	40.45	1	
Dutchess * "	47.32	45.24	46.60	1	
Erasmus "	47.73	47.28	46.21	1	
Fairfield * "	42.48	37.53	41.89	1	
Fredonia * "	44.54	41.54	44.76	1	
Granville "	45.88	48.09	42.04	1	
Hamilton * "	40.45	35.98	39.98	1	
Hartwick * "	44.92	39.66	45.38	1	
Ithaca * "	44.28	40.21	42.75	1	
Johnstown "	42.31	40.76	38.62	1	
Kinderhook * "	43.81	40.39	42.37	1	
Kingston * "	45.94	43.58	44.17	1	
Lansinburgh "	47.82	46.73	41.40	1	
Lewiston "	43.54	40.27	40.20	1	
Monroe * "	44.69	40.84	43.18	1	
Montgomery * "	44.25	39.30	41.74	1	
Newburgh * "	45.73	44.35	45.26	1	
Oneida * "	44.31	40.16	40.41	1	
Onondaga * "	45.16	41.60	42.81	1	
Oxford * "	42.80	39.85	41.44	1	
Pompey * "	40.18	36.11	39.21	1	
Redhook * "	46.11	44.65	46.28	1	
Rochester * "	44.01	41,36	42.92	1	
St. Lawrence * "	40.78	36.88	40.01	1	
Schenectady "	44.66	43.27	42.66	1	
Union "	43.11	40.51	38.70	1	
Union Hall "	46.52	45.47	45.07	1	
Utica "	40.89	39.34	37.81	1	

Localities.	Mean of Year.	Mean of October.	Mean of April.	Series of Obs. years.	Observers.
New Orleans	66.00	65.11	69.25	1	Dr. Barton.
St. Louis	54.35	52.10	58.55	8	
Fort Howard *	45.282	50.02	43.25	5	Army Register.
Fort Wolcott	50.28	54.20	45.71	5	"
Fort Columbus	53.13	55.85	49.15.	5	"
Fort Snelling *	45.77	49.50	42.49	3	"
Fort Preble *	46.92	49.20	45.01	3	"
Fort Niagará *	51.69	58.94	47.52	2	"
Fort Brady	41.84	46.43	37.20	3	"
Fort Armstrong *	51.57	55.36	51.29	3	"
Fort Monroe *	61.57	57.58	64.33	3	"
Fort Vancouver	51.75	54.00	46.00	3	"
Fort Gibson *	62.90	65.95	61.28	3	"
Fort Hancock *	41.21	45.66	43.84	2	"
Council Bluffs *	51.80	57.41	47.95	3	"
West Point	52.74	52.66	50.54	3	"
Washington	55.68	56.41	53.71	3	"
Jefferson Barracks *	57.77	59.18	56.12	3	"
Augusta Arsenal	65.24	46.76	64.29	3	"
Petite Coquille	71.40	73.10	69.28	3	"
St. Augustine	72.24	73.61	68.68	3	"
Dover, N. H.	44.50	46.60	48.70	7	A. A. Tuffts.
Summerville, Ga.	66.52	68.00	63.96	1	Dr. Holbrook.
Natchez	67.50	71.60	74.90	1	Dr. H. Tooley.
Bloomington, Iowa,	54.20	60.70	62.70	1	T. S. Parvin.
Marietta *	51.80	50.94	52.49	10	S. P. Hildreth.
Key West	76.50	77.45	74.50	7	S. Whitehead.
Nashville *	59.00	62.30	61.94	2	Prof. Hamilton.
Providence *	46.90	51.32	44.58	2	Prof. Caswell.
Dartmouth *	40.10	43.08	37.63	3	
Concord	43.37	42.38	45.60	10	M. J. Farmer.
Savannah *	66.11	68.60	67.31	2	

Abington, Va., May 24th, 1842.

On Fossil Bones found on the Surface of a Raised Beach, at the Hoe, near Plymouth. By Dr. Moore.

In our reports of the Meeting of the British Association at Plymouth, (*Athen.* No. 721,) an abstract will be found of a paper, by Dr. Moore, on those fossil bones, and a notice of the objections which were made to the author's inferences. In the memoir read to the Geological Society on the 5th of January, the substance of the former communication is given, but its principal object is to prove,—1st, That the bones could not have been derived from the emptying of a cave, bearing all the evidence of having been deposited where they were found at a very remote period, and probably long before they could

have been affected by human agency; 2ndly, That the beach with associated bones could not be a diluvial, or drift, accumulation, because it resembles in character a modern beach, and contains marine shells, and because the bones were found not in, but upon, the deposit; 3rdly, That the beach did not result from glacial action, as there are no indications of it in the neighbouring districts; lastly, he maintains his former views respecting the beach having been raised above the level of the sea, and at a period about, or probably more recent than, the time when the animals, whose remains are found upon it, disappeared. Appended to the paper was a note on a mass of limestone perforated by irregular cavities, considered, by Dr. Buckland, to be due to the action of snails, but which Dr. Moore conceives were formed by pholades.—*Transactions Geological Society.* Athenæum.

***An account of the Contortions and Faults produced in the Strata underneath and adjacent to the Great Embankment across the Valley of the Brent, on the Line of the Great Western Railway. By* MR. COLTHURST.**

The vegetable soil, on which the embankment was thrown up, rests on a stratum four feet thick, of brown or alluvial clay, under which is a bed of gravel, varying in thickness from ten to three feet, and the whole reposes on London clay of the usual characters. The surface of the valley at this part gradually slopes towards the Brent, the difference of level between the southern or more distant side of the earthwork and the river, being about twenty feet. The height of the embankment is fifty-four feet. On the night of the 21st of May, a settlement was first noticed, and in the morning the foundation was discovered to have given way, and a large mass of ground fifty feet long and fifteen feet wide, to have protruded on the south side, towards the Brent. During the four succeeding months this mass continued to increase, and the disturbance to extend, so that, at the end of that period, the surface, to a considerable distance from the base of the embankment, had assumed an undulated outline, and the subjacent strata, where they were cut into, exhibited corresponding curvatures, cracks, and overlappings in the beds, due to horizontal movements. In the earthwork itself, up to this time, the only evidence of failure, in addition to a sinking in the surface of fifteen feet, was a large crack near the top, and on the side opposite to that in which the foundation had yielded, but slanting towards the same point. Passing over the effects gradually produced during a period of nearly twelve months, at the end of which the total subsidence had exceeded thirty feet, and the swollen ground at the base of the embankment had attained an average height of ten feet, with a range parallel to the earthwork of nearly four hundred feet, and an occasional horizontal displacement of fifteen feet, the author proceeds to describe the nature of the curvatures and other irregularities produced in the strata extending two hundred and twenty feet, or from the foot of the earthwork to the Brent, the bank of which was forced five feet in-

wards; but it is impossible to render the account intelligible without the aid of diagrams. The remedy applied by Mr. Brunel was a supplementary embankment, or terrace, thrown down on the protruded mass; and it has proved effectual. In the second part of the paper, the author dwells upon the magnitude of the disturbing effects thus produced by human agency, and asserts his belief that many of the distortions visible in the solid strata of the earth may have been produced by the effects of superincumbent masses thrown down upon them by the ordinary operations of nature; but while he advocates the explanation of certain geological phenomena by means of pressure from without, he does not deny that many, and more especially the most considerable irregularities which occur in the structure of the earth, may be assigned to other causes. Ibid.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Spaulding & Isherwood's Cast Iron Rails for Railroads. *

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the model and drawings of Cast Iron Rails for Railroads, invented by Messrs. Spaulding & Isherwood, of Owego, New York, REPORT:

That they have attentively examined the model and drawings of this rail, which have been submitted to the Institute, and have discussed the merits of the invention.

They find that this *cast iron rail* consists of two curved ribs in a vertical plane, about eight inches asunder, and upon the upper one reposes a tangent bar, on which the wheels run; these three essential parts are connected and braced by a system of radial posts, combined with diagonal braces; the whole being cast in a conjoined mass, in lengths of ten feet. It is, in fact, a cast iron arch (with a level extrados) nine inches deep at crown, and twenty-one at spring, the skewbacks being joined by a wrought iron tie-bar upon the chord, to secure sufficient abutment.

The quantity of materials required for a mile of single track railway, upon this plan, with a pile foundation, as calculated by the inventors themselves, would be:

140 tons of *cast iron,*
20 tons of *wrought iron,*
1056 *oak piles,* of 11 to 17 inches diameter.

* An isometrical engraving of the *cast iron rail* under consideration, will be found in the American Railroad Journal, for July 15th, 1841, accompanied by a very lucid description, written by the inventors themselves, and this engraving and description have been further circulated through the country in a descriptive memoir, issued in pamphlet form, by Messrs. Spaulding & Isherwood, for the information of the public. Those who feel an interest in this matter can easily refer either to the valuable periodical above mentioned, or to the descriptive pamphlet of the inventors—copies of which they would, doubtless, furnish, for the information of any who might contemplate the use of their rail. Com. Pub.

The amount of wrought iron was originally designed to be fifteen tons per mile, but additional cross ties have since been judiciously proposed by the projectors, to strengthen the rail against lateral action.

In the Railroad Journal, for July 15th, 1841, we find a detailed account of this rail (as originally projected,) illustrated by a very lucid isometrical drawing, which seems to render unnecessary a more particular description by us; and to this we refer those who wish to examine more minutely into its structure.

A railway constructed upon this plan would consist, in chief, of a series of cast iron arches, of ten feet span and one foot rise—each line of rails forming, indeed, *a continuous arched bridge*, in which the thrusts of the separate arches would be neutralized by the chord bars, and which would be kept in place laterally, by direct and diagonal transverse ties, of wrought iron.

This mode of constructing bridges of cast iron, *is not novel;* it is, in fact, the same in principle as that executed in the bridge which carries the London and Birmingham Railway over the Regent's Canal. near Chalk Farm; and the same idea—that of springing arches of cast iron from wrought iron tie-bars, secured to their skewbacks—has been put in practice on other English railways. (See Brees' Railway Practice, and Simms' Public Works of Great Britain.)

But the actual application of the trusses of such bridges, in a continuous line, to form the rails of railways, *is new*, (though the mere suggestion of a similar plan has been before made,*) and upon this adaptation of a known method of construction to a new use, must rest *the claim to novelty* of the rail under consideration.

Messrs. Spaulding & Isherwood propose to establish their cast iron superstructure upon foundations of oak piles, each from eleven to seventeen inches in diameter, and to be firmly driven by a ram of 1200 lbs., with twenty-eight feet fall.

In answer to a letter addressed by us to the inventors, they state: that twenty feet lineal of single track, upon this plan, has been for eight months in use, upon the Ithaca and Owego Railroad, daily traveled at a pace exceeding ten miles an hour, by an eleven ton, six-wheeled locomotive, with passengers and freight in trains of ninety tons average weight—amounting in all to about 24,000 tons gross, transported over these rails; that no rails have yet broken; that the piles do not settle; that the freight referred to was carried in cars without springs: and, that this part of the track remained wholly free from snow, when other portions of the same road were deeply covered.

The inventors also inform us, that, with an hydraulic press, they tested the strength of two patterns of their rail—each of ten feet span.

The first, weighing sixty pounds per yard, broke in its *lower arch*, under a weight of twelve tons; but the upper arch and chord bar

* Some years ago, Henry R. Campbell, Civil Engineer, of this city, proposed to use each separate truss of a cast iron bridge as the sustaining part of a line of wrought iron rails—designing, in this manner, to pass the Schuylkill river, near the city, with spans of 125 feet; which, like those of the plan before us, were to be retained in position laterally, by wrought iron tie-bars, and which was equally to be without a floor.

were not broken, until the latter (one inch in diameter) was torn asunder by augmenting the strain.

The second, weighing seventy-eight pounds per yard, (the same as those in trial on the Ithaca and Owego Railroad,) and having a one and a half inch chord bar, sustained twenty, but fractured in its *lower arch*, with twenty-two tons weight—though even then it did not fall down.

These experiments show that this rail, when of the weight of seventy-eight pounds to the yard lineal, possesses abundant vertical strength for railway purposes, and its practical use upon the Ithaca and Owego Railroad—as far as it has gone—is quite satisfactory, as we are informed, though we have also received intelligence, from a correct source, that in a similar experiment tried upon the New York and Erie Railroad, two rails were fractured at the ends, after a very brief use indeed; and it is evident that the amount of the passing trade, in the former case, has not yet been sufficient to fully test its merits.

As this structure is designed to stand in relief, about two feet clear of the ground, no one in a northern climate will lose sight of the advantage it will therefore possess in being easily kept clear of snow; and in the passage of small streams, or such as are not exposed to heavy drift, this railway will form a bridge for itself, without requiring the aid of a particular building for its use.

In curves, these rails will form a succession of chords of ten feet, and as piles, or any similar supports, of less base than altitude, present of themselves but little lateral stability, it would seem probable that the constant impinging of the wheels in the multangular line formed by the series of chords—especially in curves of small radii—would render the maintenance of the way difficult in such places, if, indeed, fracture did not result from this action, (notwithstanding the transverse ties,) owing to the apparent weakness of the rails in the centre; but actual experiment alone can determine what value there is in this objection.

The great depth of the rail at the skewback, will, in case of the subsidence of any pile—the rail revolving upon the opposite springing line as a fulcrum—cause the adjacent joints to open at top, to an extent at least double of what would result from the same settlement in an ordinary rail on detached bearings, three feet asunder; besides, bringing a strain on the subsiding joint well calculated to produce fracture. All which is certainly objectionable.

The risk of accident upon a decaying pile road, laid with these rails—in consequence of their elevation from the ground—ought not to be overlooked; for experience shows that in the general repairs of railways, timbers are not always renewed before they fail, though life should pay the forfeit of neglect: and hence it would seem, that a due regard to public safety would require that the timbers of such roads should be (if possible) protected from decay; but this would considerably enhance the cost per mile.

If within reasonable limits of cost, the consecutive arches of such a structure could be established upon solid, unyielding, and indestructi-

ble piers, it would then become an economical cast iron bridge, with a series of small spans, *and its complete success on tangent lines could not be doubtful;* but the Committee, as at present advised, are strongly inclined to the belief that, under the usual circumstances of railways, it would be difficult, if not impracticable, to procure, at a sufficiently moderate expense, that stability of foundation which, in their view, seems indispensable to the success of such a plan.

Finally, we will conclude by observing, that as the most serious objections to this rail involve considerations of comparative working cost, and as these can only be determined by experiments on *a sufficient practical scale,* we hope that the means will be afforded by some of our railway companies, to enable such trials to be made under the direction of the ingenious projectors—both on short curves and high embankments, and in the passage of streams—for the rail in question evidently has enough vertical strength, and possesses other important advantages, sufficient to recommend it for impartial experiment; but though there is strong reason to hope for successful results, *the Committee are not yet prepared to advise its general employment upon railways.*

By order of the Committee,

April 14*th*, 1842. WILLIAM HAMILTON, Actuary.

Note by one of the Collaborators.

The successful application of cast iron to form the rails of railways —which is even now a desideratum—will, when the admission of foreign railway iron, *duty free, shall cease,* evidently become of such importance in this country, that the experiments upon Spaulding & Isherwood's ingenious cast iron rail, which are now in progress in the state of New York, have deservedly excited considerable interest. Its vertical strength is unquestionable—indeed, far superior to that of any rolled iron rail, of the same weight, now in use—and it is to be hoped that those gentlemen will persevere in their trials and modifications of the pattern, until the properties of the invention shall be fairly developed by practice.

To enable the cost of this cast iron superstructure to be compared with that of the seventeen railway tracks of rolled iron, of which we compiled an estimate in the last volume of this Journal, page 158, the following is submitted:

Estimate of the probable Cost of a Mile of Single Track Railway, upon the Cast Iron Arch plan of Messrs. Spaulding & Isherwood.

140 tons of *cast iron,* from the Blast Furnace, delivered upon the line of road, at, say $45, per ton, .	=$6300 00
20 tons of *wrought iron,* ties, &c., complete, at, say $100 per ton, ...	= 2000 00
1056 *oak piles,* including delivering, driving, &c., and laying the superstructure, as estimated by Messrs. S. & I., conformably to the known expense of piled roads,	= 1500 00
Total, ...	=$9800 00

If this estimate is not incorrect, it would seem that the *cast iron arched railway* is likely to be more economical, in first cost, than the usual superstructure of rolled iron edge rails—to the extent, at least, of the saving in embankment, drainage, &c., which may be effected by the former. M.

Calderhead's Carpet Loom.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an improvement in the Loom for weaving Carpets, &c., invented by Mr. Alexander Calderhead, of Philadelphia, Pennsylvania, REPORT:

That Mr. Calderhead's loom is a material modification and simplification of the Jacquard and other draw looms, for weaving carpets and other figured cloths. It dispenses with all machinery above the working parts of the common loom, and is thereby so reduced in height, that it may readily be placed in a common apartment without requiring the removal of the ceiling. The *harness* consists simply of *heddles*, or heilds, made of wires, about twenty-four inches long, and each pierced with an eye, for a thread of the warp to pass through, in place of the mails, twine, and leads, of the Jacquard harness. The heddles work vertically, in holes through two boards, or plates, resembling cumber-boards, the upper of which may be called the *rest-board*, and the lower the *guide-board.* The heddles have each a head at the top, which prevents their falling through the rest-board, and enables it to raise them when raised itself. The *cylinder*, or trunk, is a four or six-sided long and slender box, with pivots at the ends, and it extends horizontally across the whole width of the loom directly beneath the heddles; it is pierced on each side with holes corresponding to those of the cumber-boards, and the *pattern-cards*, or apron, rest upon it, and revolve with it—so that when the cylinder is raised and the rest-board lowered, the blanks of the card raise the proper heddles, while the remaining ones drop through the holes of the card, and of the cylinder beneath it, to form the sheed, or opening, for the shuttle to pass through. Thus the width of the sheed is equal to the distance which the heddles penetrate into the cylinder, and the upper and under threads of the warp are stretched alike. The cylinder turns on bushes, in a frame which slides vertically, and which, being raised by levers connected with the treadle, raises the cylinder. But the cumber-boards slide vertically and separately in the same frame, and the cylinder as it rises lifts the guide-board, with a part of the heddles; but the sliding frame acts upon two levers, supported from the cross-beam above, and thereby lowers the rest-board, and allows the proper heddles to descend into the cylinder. The guide-board is suspended from the rest-board, so that it cannot fall too far below it when the cylinder descends; and by means of a wheel at the end of the cylinder—having as many inclined teeth as the cylinder has sides, and these teeth acted upon by a kind of ratchet hooking against them—the cylinder as it descends is turned, so as to bring the next side uppermost, and bring the next figure of the pat-

tern cards into operation when the cylinder is raised again. By means of a like wheel on the other end of the cylinder, its motion may be reversed, and the pattern moved in the opposite direction.

The Committee believe the whole contrivance above described to be original, and exceedingly simple, ingenious, and effective, costing less than the machinery for which it is proposed as a substitute, in the outset, and producing a considerable saving in subsequent repairs of the twine required in other harnesses. The inconvenience arising from the stretching of the twine, is in this loom entirely avoided. It is alike adapted for cumber work, where the figure varies throughout the whole width, and point work, where the figure is symmetrical. It may be used for fabrics of two or more plies, or thicknesses, and requires for them merely a single pattern. The only objection to its use which has occurred to the Committee, is, that the fly or downy matter from the warp may in time clog the cylinder; but if this should be the case, that part may be easily removed and cleaned out, and there is little reason to apprehend any difficulty from this source. The committee would warmly recommend this invention to all manufacturers of carpets and figured fabrics, while they accord high praise to the meritorious inventor.

By order of the Committee,

June 9th, 1842. William Hamilton, Actuary.

Practical & Theoretical Mechanics & Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Comparative Value of various forms of Chimney Caps and Ventilators. By Thos. Ewbank *and* J. L. Mott.

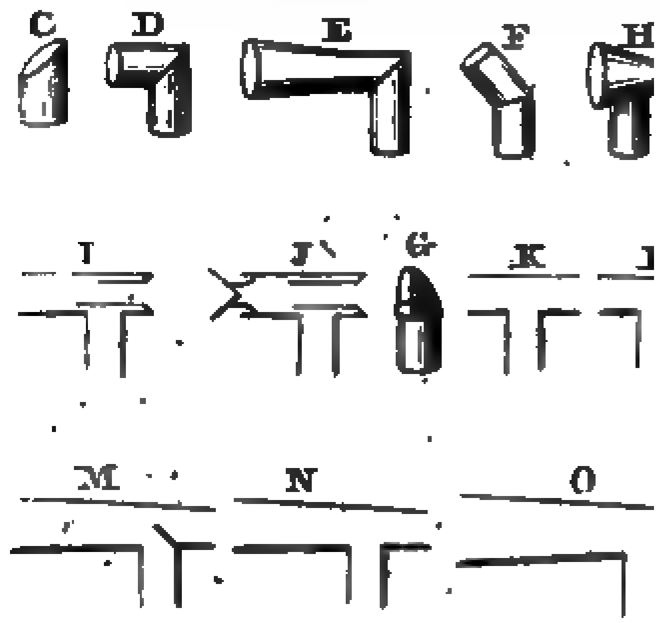
To the Committee on Publication:

Gentlemen—The following experiments by Jordan L. Mott, Esq., and myself, are submitted for insertion in the Journal of the Franklin Institute. Yours, respectfully,

New York, July 1st, 1842. Thomas Ewbank.

The object of these experiments was to determine the comparative value of various forms of chimney caps and ventilators. To do this with a tolerable degree of precision, a uniform current of wind of sufficient volume and force, was necessary; and it was equally requisite that the model of every cap tried should be placed in the same favorable position in the experimental current. We endeavored to realize these conditions in the following manner: In Mr. Mott's iron foundry three cylindrical bellows, each twenty inches diameter, and thirty inches stroke, are employed; the pistons are moved alternately by a triple, or three throw, crank. From these bellows the aerial current, or blast, was derived; the wind from all of them was conveyed about twenty feet through a five inch pipe, where it issued in a horizontal direction through the tube A, whose orifice was three inches in diameter. To render the blast as equable as possible, the steam engine that worked the bellows was kept going at a uniform speed during

the time occupied in experimenting. The blast, however, was not, after all, very uniform, and the consequence was a slight oscillation of the water in the gauge that measured the results.



Eight inches from the open end of the blowing pipe, A, a glass tube, B, an inch and a quarter bore, and twenty-eight inches long, was secured in a frame. Its lower end descended into a vessel of water, as represented, and to its upper end was fixed a ferrule, *i*, of tin plate. To this ferrule the vertical tubes of the caps were accurately fitted, so as to be slipped on and off without disturbing B. The models were made of tin plate, and the vertical tubes attached to them were all of the same dimensions, viz: $1\frac{1}{4}$ inch long and $1\frac{3}{16}$ inch bore. The glass tube which may be supposed to represent a chimney, was designed, as the reader will have already perceived, to measure the degrees of rarefaction produced within it by the caps—the ascent of the fluid indicating the effect of the blast of wind on each. Except when otherwise noticed, the axes of the caps, or horizontal tubes, were made to coincide with that of the current. With the view of verifying the general results, and to detect any variation in the force of the blast, from slight changes in the speed of the steam engine, the experiments with each cap were repeated, at short intervals of time, but no very obvious changes in the results here recorded were observed.

Experiment I.—The first experiment was with the tube B, as figured in the cut. It was raised till the orifice of the ferrule was in the centre of the blast; but in no part of the current was any rarefaction produced. The water was neither elevated nor depressed within the tube. Had the upper end been inclined towards A, wind would have entered and displaced the water from the bottom of the tube; and, on the other hand, had it been inclined in the opposite direction, a slight ascent of the fluid would have followed; but it was not deemed of sufficient importance to try either.

Experiment II.—The tube C was now slipped on the ferrule in the position in which it is figured. It will be perceived that at the side away from the blast, a portion is removed, as if to form with a

similar tube a mitred joint, or a right angled elbow. With this device the water rose in B from 1¾ to 2½ inches above its level in the vessel. By turning the open part of C till it was nearly parallel with the blast, little or no change in the extent of rarefaction took place.

Experiment III.—D was next tried. It consisted of two tubes like C, united at right angles. When the horizontal branch was in the direction of the current, the water oscillated in the tube from 1½ to 2¼ inches. Upon turning the cap till its axis formed an angle of 45 degrees with that of the current, the liquid column rose to 3¼ inches; and when the angle was 90 degrees, the water fell to 2½ inches. An elevation, however, greater than was obtained when the cap ranged with the blast. The cap was next turned to its first position, and a conical tube, six inches long and two inches diameter at its wide end, added to it, as figured at E. To our surprise, no further elevation of the fluid took place. The central current of the blast being received against that part of the vertical tube opposed to it, was, probably, too strongly deflected to allow other portions of the current to sweep close around the horizontal branch. Had the cap D resembled the one marked F, there can be no doubt of the effect being increased, as the wind would then embrace, and impinge upon, a larger surface. Unfortunately we had not prepared any models of cylindrical caps at various angles, i. e., where the caps proper were inclined upwards like F. The next figure exhibits an approach to this plan, and when compared with C, which it so nearly resembles, exhibits a decided improvement.

Experiment IV.—The cap G consists of a vertical tube, with a head piece extending over three-fourths of its upper, or discharging, orifice. The back of the hood, which receives the blast, forms an angle of about 30 degrees with the side of the pipe to which it is attached. This cap raised the water in B from 3½ to 4½ inches, being double the elevation which C produced. Deviating the position of the opening, with regard to the current, diminished the effect.

Experiment V.—The conical cap H was now placed in the blast, upon which the fluid ascended in B from 2½ to 3½ inches. Three models of this cap were tried; they were all of the same diameter at the mouth, and the vertical tubes were attached to them at the same distance from the mouths, viz: three-eighths of an inch; but their lengths varied, being respectively 3, 3⅜, and 3⅞ inches. There were no very observable variations in the altitude of the liquid column produced by them, but the only one that raised it to 3½ inches was the longest—the one last named. When the mouths were turned till the axes of the cones formed an angle of about 45 degrees with that of the blast, the water commonly fell in the tube, though not uniformly so; but what appeared singular, when the axes of the cones were at 90 degrees with the current, the water actually rose to 4½ inches! On several trials this unexpected result followed.

Experiment. VI.—The next experiment was with the cap figured at I. The model was made from caps on sale in the city. The outer pipe, or case, was 4⅞ inches long and 1½ inches bore. The e was three-fourths of an inch bore, and with the conical

ajutage to catch the wind, 2½ inches long. This cap raised the water 4½ inches. When its axis was a little inclined to the blast, no sensible change in the elevation of the water in B followed; but when the angle with the axis of the blast was at 45 degrees, the water fell to 3½ inches, and at 90 degrees the water stood only at half an inch. (This, and the remainder of the figures, are in section.)

Experiment VII.—The inventor of the last cap has applied near its open end (by two or three strips) a cone, as represented at J. The object of this is to prevent currents of wind entering that end, and so driving the smoke down the chimney, instead of drawing it up. To ascertain the effect of this arrangement on the exhausting power of the cap, the model J was made in all respects the same as I, the cone excepted. On applying it to the current, the water rose in B to an elevation little more than half of that produced by I, being only 2½ inches. When the cap was turned to 45 degrees, the water fell to 1½ inches, and at right angles it sunk to a level with that in the vessel. This effect might in some degree have been anticipated, since the wind would, in being thrown from the sides of the tube, be apt to catch hold of the cone, and be turned into the cap. On this account, the base of the cone should not project in the least degree over the mouth. The cone, too, retards the free exit of the smoke.

Experiment VIII.—The next devices tested were such as I have applied to charge siphons, and also for producing a vacuum by currents of steam—the model marked K consisting of a horizontal and perpendicular tube of the same bore, united at right angles. The horizontal one was 2½ inches long. On placing this cap on the glass tube, no rise of the water took place, but rather the reverse, for portions of wind descended and drove out the water occasionally. When the axis was inclined nearly 45 degrees to the blast, the water *rose four inches.* At right angles it was at two inches.

A projecting piece was now placed within the cap, so as partly to cover the orifice of the perpendicular tube; (see next figure, marked L.) On trying this, the water rose 4½ inches; inclining the cap raised it to 5½ inches; as the projecting piece retarded the current through the tube, it was pressed down to make the passage way larger, upon which the water rose a little higher. Various conical ajutages were now tried, as figured at M, and with one six inches long, and two inches diameter at the wide end, the water rose 8½ inches. No additional rise of the column was obtained by changing the position of the cap within the current.

Experiment IX.—The same cap was now tried again, but with the projecting piece entirely removed, (see N.) The water now rose 15 inches, and oscillated from 13 to 15. A short conical tube, whose mouth flared out to two inches, was next inserted into the small end of the cap, with a view to draw more air through it; this caused the liquid column to ascend at once to 18 inches. A longer tube, whose mouth reached to the orifice of A, caused the water to rise entirely out of the tube—28 inches! These increased effects, it will be remembered, are caused by an *interior and exterior* blast—the wind sweeping *over*, as well as *through*, the cap.

Experiment X.—A cap, precisely the same as the last, except the horizontal one, being 1½ inches bore, and as figured at O, raised the water to 18 inches, and kept it oscillating from 16 to 18. The short diverging mouth piece mentioned above, was applied to the receiving end of the cap, and raised it from 22 to 24 inches!

From these experiments it would seem that a chimney cap, or ventilator, made like the last figure, is very far superior in its effects to any other yet known; and, what is of some consequence, the form is almost as simple as the simplest. A diverging tube might be attached to the end which receives the current, but the mouth of this should not greatly exceed the diameter at the junction with the vertical tube; if it did so, it would diminish the effect of the wind, in sweeping along the sides of the discharging branch. The under side of the receiving end of the cap should project beyond the upper one, in order to catch the descending currents more readily. This feature is figured at N and O.

Perhaps some readers of the Journal may find time to repeat and extend these experiments. There are several old chimney caps which have not been included, especially *revolving* ones. At the first favorable opportunity, we will, if not anticipated, pursue the subject.

Notice of the Use of Auxiliary Steam Power in Propelling Vessels.

The small steam engines fitted in the "Vernon" and "Earl of Hardwicke" Indiamen, to try the advantage of small auxiliary power to propel merchant ships during calms and light winds, have been removed. This experiment may, therefore, be considered a failure, for although less time was occupied in the voyage, the loss of room for freight, together with the expense, more than counterbalanced the advantages.

New and Simple Method of Obtaining Mezotint Grounds.

It gives me some pleasure to be able to announce that I can form a tolerably good mezotint ground on a plate, by passing it along with a piece of common sand-paper five or six times through the rolling printing press, with rather a tight pressure. The depth of color, when printed from, does not quite possess the intensity of those executed in the usual manner; but the method answers exceedingly well for prints which it is intended to finish in colors.

I remain, &c.

Laurence Brunton.

March 14, 1842.

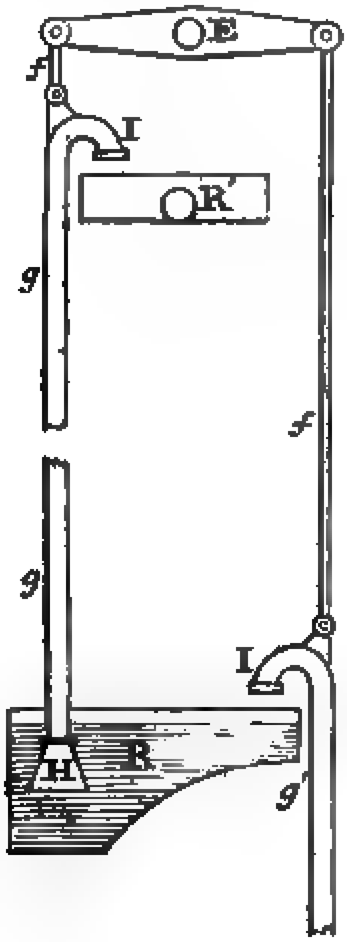
Mech. Mag.

Walker's Hydraulic Engine.

Mr. Walker's apparatus depends for its action upon the momentum acquired by fluids when in motion; several of them have been completed to be worked by manual power, or by wind, and forwarded to climates where machinery for this purpose, constructed of less durable materials, has been found a subject of continual annoyance and expense.

The above engraving represents one of Mr. Walker's Elevators, in its complete form. A is a winch-handle on a shaft, which carries a

toothed driving-wheel, B, working into a pinion, C; upon the pinion-shaft there is an eccentric, from which a connecting-rod, *d*, passes up to the over-head beam, E. From each extremity of the beam E, two pump rods, *f*, *f*, pass down to the two elevators, or water cylinders, *g*, *g*, which may be of any convenient length, say from thirty to forty feet, and from one and a half to three inches in diameter; these cylinders are closed at their lower extremity, H, by valves opening upward.



On turning the handle A, a rapid motion s given to the pinion-shaft and eccentric, which has an inch and a half throw; the connecting-rod, *d*, being attached intermediately to the beam, E, a throw of three inches is given to the elevators, which, thus receiving a rapid alternating motion, deliver a stream of water from their nozzles, I, into the cistern, or receptable, from which it flows in any required direction.

The second engraving shows an arrangement for drawing water by means of this apparatus, from wells of a greater depth than could be advantageously accomplished by a single lift. E is the working beam to which two elevators are attached, the first, *g*, *g*, raising water from the reservoir, R, into R', the former being supplied by the second elevator, *g'*, *g'*, from the well, W.

The pinion-shaft is in some cases fitted with two, three, or more, eccentrics, which give motion to a corresponding number of elevators contained within the same frame, so as greatly to increase the power of the engine, without adding much to its bulk. It will be apparent that as the one elevator, with its contained column of water, is exactly counterbalanced by the other, the machine is constantly in a state of perfect dynamic equilibrium, and therefore the motion communicated to the machinery, and thence to the fluid, produces a direct action, raising the largest quantity of water with the smallest possible expenditure of power.

What the capabilities of this engine may eventually prove to be, remains to be ascertained; in the machines already completed, the quantity of water raised far exceeded the performances of any description of pump hitherto employed; but as none of the machines were sufficiently large to employ the whole power of a man, mechanically considered, no data have yet been obtained upon which to found any calculations.

Mech. Mag.

Improvement in Slide Valves.

Fig. 1 is the section of the cylinder valve, piston, &c. A, represents the piston; B, the piston rod; C, the cylinder; D, slide; E, valve spindles; F, bottom steam passage around the cylinder; G, bottom exhausting passage; K, top exhausting passage; L, top steam passage.

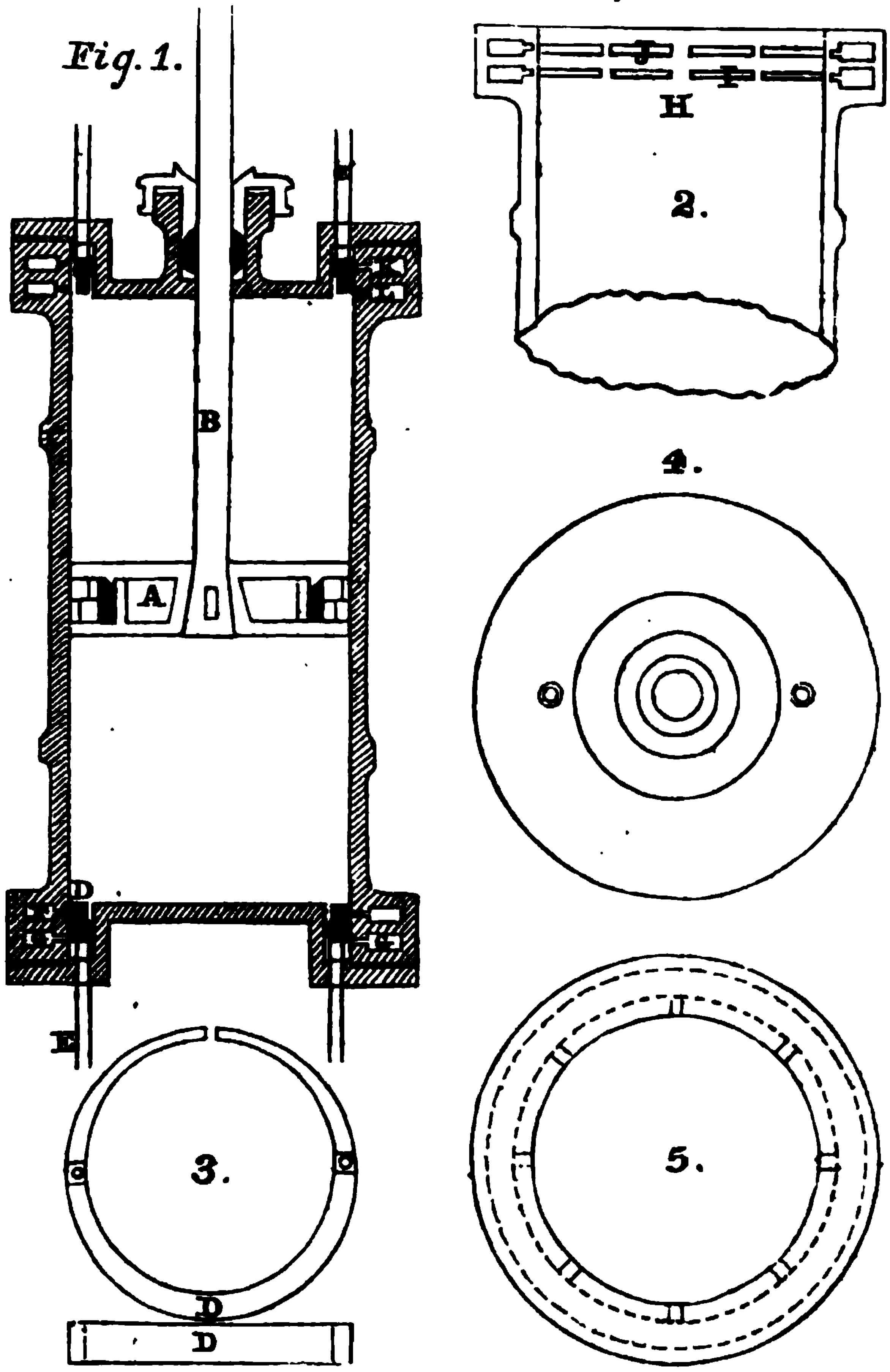


Fig. 2. H is intended to represent a section through the ports, and steam passage, &c.; I, is the steam port; J, the exhausting port.

Fig. 3. D represents the valve, being a round ring.

Fig. 4 is the top view of cylinder cover.

Fig. 5 is top view of cylinder through the ports, showing the ribs.

The utility of this valve consists in giving steam much quicker, in consequence of the ports being all round the cylinder, and the valve traveling, therefore, about one-tenth part the distance of the common D slide valve. It does away, also, with a deal of work, such as the

D valve, valve jacket, packing blocks, &c. The steam may be also, by this means, worked expansively to a greater advantage than at present, as it is necessary to have an additional expansion valve for the present D valve, when it is desired to work steam expansively.

THOMAS MERITON.

Mill Wall, January 27, 1842. Ibid.

New Steam Engine erected by Messrs. Rennie, at Mr. Cubitt's Factory, Thames Bank.

The two-cylinder, expansive engine, invented by Hornblower, and afterwards, with but slight modifications, brought into extensive use by Woolf, is well known to all persons acquainted with the history of the steam engine. The cause, also, of its subsequently falling into disuse, is no secret; it was found to perform no more duty with two cylinders than could be done, at much less cost, with one. Not that more duty was *previously* done with one cylinder, but that in the progress of improvement it was discovered, or supposed to be discovered, that steam could be worked expansively as well with one cylinder as with two; and so the cost of the second cylinder, and the extra friction and radiation attending the use of it, saved. Abandoned in Cornwall, where it first found favor, and long maintained a strong hold on public opinion, it has now, strange to say, been re-produced in the metropolis, by engineers of the first eminence; and, stranger still, with a degree of success which, if there be no mistake in the case, shows not only that it has been most undeservedly shelved by its Cornish patrons, but that it is in truth the best sort of engine which has ever yet been constructed.

The engine which has thus taken the engineering world by surprise, is one which has just been erected by the Messrs. Rennie, at the extensive manufactory of Mr. Thomas Cubitt, Thames Bank. It differs in no respect, as far as regards details and arrangement, from the ordinary rotative engine of Woolf; nor is any such difference claimed credit for by the makers. There are the two cylinders, side by side, as of old—a small one, into which the steam first passes at a high pressure from the boiler, and a larger one, into which it expands (five times;) also the ponderous beam, fly-wheel, rotating shaft, &c. The only difference we could observe, consists in the workmanship, which is of a very superior description, and in a little better clothing (perhaps) of the cylinders. The effective working power is stated to be equal to sixty horses, and the consumption of fuel to be *no more than 2.2 lbs. per horse power per hour.* It is this which is the startling result. So small an expenditure of fuel has never been before reached by any rotative engine, of any description; not even by the same sort of engine, when in the friendly and fostering hands of Woolf. That it has been actually realized in the present instance by virtue merely of better workmanship and better clothing, no person can be expected to believe, except on the most indisputable evidence; and such evidence the respectable manufacturers of the engine will, no

doubt, themselves allow, still remains to be furnished. We were assured that it was doing the same work which two or three old engines, of the cumulative power of sixty horses, had been in use to perform, and have no reason to question the fact; but that, evidently, is a very uncertain test of its real power. We were also shown indicator diagrams, which exhibited a very small average deficiency of pressure; but the insides of steam cylinders and working shafts, as all the world knows, often tell very different tales. The means taken to keep a correct account of the quantity of fuel consumed (Welsh coal) appeared to be also most unexceptionable; and if we could only admit sixty to be the proper divisor to employ, we make no doubt of 2.2 lbs. per horse power per hour being a true result. Proof, however, of the sixty horses' power is still wanting—such direct and positive proof as *actual performance* alone can supply, and that not during short trials of an hour or a day at a time, but during trials carried on for several days successively, and under the same circumstances, precisely, in all respects. Ibid.

Condensation of Steam by Cold Air. Craddock's Process.

The peculiar feature of my invention is, the communication of a rapid motion to the condenser—independent, of course, of the motion which the vessel or locomotive may have, to which my condenser is attached. It will be unnecessary for me to detail my preliminary experiments, or the various forms which I have given to the condenser during my investigations; I will, therefore, at once, describe the apparatus in that form which, from my present experience, seems to me the best. A hollow axis is supported by proper bearings, in a vertical position. The lower end, or that at which the steam is introduced, is open, and works on a pivot fixed on the bottom of a chamber, on the top of which is a stuffing-box, through which the axis passes. Near the upper or closed end of the axis is an enlargement, or chamber, from which proceed, at right angles to the axis, a number of radial hollow arms, into each of which the ends of a series of small copper tubes are inserted; these, of course, are parallel to the axis; their lower ends are inserted into other radial arms fixed near the bottom of the axis, and similar to those at top, excepting that their ends do not open into it. The radial arms at the bottom are all connected by their ends opening into an annular chamber. A rapid rotary motion is given to the condenser by the steam engine to which it is attached, the result of which is the cooling of the apparatus, and, consequently, the condensation of the steam which has been introduced into the small copper tubes. The condensed steam, or water, falls into the lower radial arms, and is thrown from thence into the annular chamber by centrifugal force; a small pump is affixed to this chamber, and its piston-rod is attached to the clip of a fixed eccentric, supported round the movable axis of the condenser. As the pump travels about this eccentric, its piston-rod works to and fro, and the water is removed from the condenser. The arrangement of the minor parts of

the apparatus, such as the conveyance of the water to the boiler, the connexion of the air-pump, &c., cannot be illustrated without drawings. I may just remark, here, that the force-pump for the removal of the water is not absolutely necessary, as the air-pump may be made to effect that object. My experience, however, demonstrates that it is effected to greater advantage by its use.

I have attached a condenser of this kind to a high pressure engine of five horses' power, and, by giving it a velocity of eleven miles per hour, the water is drawn off at a temperature varying, with that of the air, from 90° to 120° Fahr. The column of mercury supported by the vacuum is not quite so high as it should be, according to the temperature of the water; this, however, is owing to the imperfection of some of the joints in the condenser, and will soon be remedied. The power gained is more than double that required to work the condenser and air-pump. The amount of surface required to condense a given number of cubic feet of water per hour, depends on the velocity at which it is intended to work the condenser, and the temperature at which the water is drawn off. It does not appear to me advisable to draw the water off at a temperature lower than 150°, for a given abstraction of heat at lower temperature affects the height of the mercurial column much less than at a higher; and any one familiar with the law according to which heat passes from one body to another, need not be told that the same surface will condense much more steam into water at 150° than at 100°. A condenser having a velocity equal to twenty miles per hour, and the water being drawn off at 150°, will require about twenty square feet of surface per cubic foot of water per hour. The strength of the copper I have hitherto used is one pound to the square foot, but I intend using it much lighter in future. The weight of a condenser equal to condense ten cubic feet of water per hour, will be from eight to ten hundred weight.

Besides the advantages which my mode of condensation possesses, in those situations where a supply of water cannot be had, I believe it possesses other, and scarcely less important, ones. By my condenser returning the water to the boiler, I am enabled to use a tubular boiler, without experiencing that inconvenience which almost precludes their use, in combination with the ordinary system of condensation, namely, the liability to become choked up by the deposit from the water. Although the condenser with which I am working is far from being tight in its various joinings, I have worked my engines constantly for four days, without adding any water to the boiler; and I have no doubt that the condenser and engine I am now fitting up, and to which I hope very soon to be able to call the attention of engineers, will give results even more satisfactory than those at present obtained.

THOMAS CRADDOCK.

Ibid.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1841.

With Remarks and Exemplifications by the Editor.

1. For improvements in machinery for *Hoisting Weights, &c.;* John B. Holmes, Boston, Massachusetts, June 7.

In this machine the rope, or chain, to which the weight is suspended, winds around two grooved drums, to each of which there is attached a cog wheel, mashing into a pinion that lies between the two, and by which they are actuated, the two cog wheels having the same number of teeth, to insure the same motion to the two drums. These drums, together with their cog wheels, project outside of the frame, one of them turning on a spindle attached to the side of the frame, and the other on a spindle which passes entirely through it—the part of it which is within the frame being adapted to receive one of a train of wheels for multiplying the power. One of the drums has cogs cut upon its outer edge, which take into the teeth of a pinion on the axle of a grooved roller, for the purpose of making pressure upon the rope, or chain, to prevent its slipping.

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, are—First, the arrangement of the barrels which hold the rope without an outside framing, as described. Second, the combining therewith, in the manner set forth, a grooved roller, to press the rope against the barrel on its passage therefrom, for the purpose of preventing any slipping of the rope which the action of the weight at the other end has a tendency to produce—being constructed and operating as described."

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2. For an improved mode of *Block Printing* on various kinds of Fabrics, and for Apparatus, &c., for that purpose; Robert Hampson, Manchester, England, June 7.

The printing block is attached to a cross frame, which slides on straight edges at the four corners of the main frame, and has a rod attached to its middle that slides through a hole made in a set of arms at the top of the main frame. To the upper end of the rod there is a band attached, which passes over two pulleys, and has appended to it a counter weight, to balance the whole.

The fabric to be printed is drawn through the machine, and over the bed on which it rests, to receive the impression, which is given by means of blocks, in a manner well known to machinists. The colors are so arranged in separate sieves as that they can be drawn apart to receive new colors, and then brought together again to apply the colors to the block; the sets of sieves are placed upon a platform provided with wheels, running on rails. The platform, with the colors, is passed under the block, which is then let down to receive that which is wanted. The sieve is then drawn away, and the block de-

scends upon the fabric, to impress the pattern; and the operation is in this manner repeated.

Claim.—"I declare that I claim as of my invention the apparatus, or machinery, constructed as set forth, for printing with blocks on woven fabrics of various kinds; that is to say, I claim the combining of a block for printing in various colors with the apparatus, or mechanical agents, for causing said block to descend in a perpendicular direction in order to take up the color from the sieve, or sieves, and to impress the pattern, or design, upon the fabric; said apparatus, or mechanical agents, consisting of the cross frame, the arms, the straight edges at the corners of the main frame, the rod, the band, and counter weight, with their appendages; the whole being so connected as that by raising the counter weight the cross frame and block will descend, and the color be received on the block, or the impression given to the fabric; and I claim the same however the said mechanical agents and contrivances may be modified or varied in size, form, proportion, or other particulars not departing from the principle of my invention; but I do not claim as my invention such mechanical agents, or contrivances, separately, but only as combined to effect the purpose aforesaid; nor do I claim as part of my said invention the apparatus hereinbefore described for traversing the coloring apparatus to and fro, by means of a railway and carriage running thereon—the same, although invented by me, having been by me used and practised previous to the grant of the said letters patent; nor do I claim as of my invention the arrangement of rollers and connected apparatus for causing the fabric to traverse, or be drawn over, the printing table, and conveyed away when printed. And I further declare that I claim as of my invention such coloring apparatus as hereinbefore described, in which several sieves are separated and held apart, to admit of the several colors being distributed and traced, or spread, thereon, without admixture or interference one with another, and whereby the sieves are afterwards closed, or brought into juxta position, in order to the colors being taken up by the block, so as to produce at one impression of the block, or pattern, or design, or parts of a pattern or design, in several colors, arranged contiguous, or near to each other, as hereinbefore described; and which coloring apparatus I claim, whether the same be used in conjunction with the machinery before described, or with the common hand block, or otherwise, and under whatever other modification."

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3. For an improved mode of Framing and *Bracing the Arms of Paddle Wheels* of Steam Vessels; Wm. F. Julian, Hartsville, Bartholomew county, Indiana, June 7.

The arms are bolted to a cast iron centre plate, in the usual manner, and kept at equal distances apart, by wedges driven in between them. Two sets of braces are arranged between the arms, the braces being provided with short tenons, fitting into long mortises in their sides, the said mortises being sufficiently long to allow the braces to be drawn in towards the centre of the wheel. The two sets divide

the length of the arms, between the periphery of the outer plate and their outer extremity, into three parts. The centre plate has a flanch with notches, into which the arms fit, and the braces are drawn tight towards the centre of the wheel, by means of radius screw bolts that pass through their middle and the flanch of the centre plates.

Claim.—"What I claim, and desire to secure by letters patent, is the within described manner of inserting and drawing up the braces, by means of brace-bolts attached at their inner ends to the circular plate which receives the ends of the arms; said bolts being furnished with screw nuts, which are to bear against the middles of said braces, as described and represented; the braces being inserted and retained in place by means of short tenons, and left free to slide within the arms, as set forth. I also claim, in combination with the foregoing mode of bracing by means of the brace-bolts, the employment of the wedges between the inner ends of the arms."

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4. For an improvement in the machine for *Turning Straight, Curved, or Taper, Work*—such as Fork and Shovel Handles; Collins & Wistar, assignees of Stacy Costill, Philadelphia, Pennsylvania, June 7.

The piece of wood to be turned is fixed to a mandrel, and passes through a hole in a plate attached to a slide rest. The hole in the plate is provided with three segments that slide in radial grooves made in the plate for the purpose of regulating the size of the hole to suit the size of handle required to be turned. The segments are all moved together by a second plate, which has three eccentric grooves cut in it, that receive projections from the back of the said segments. The turning of the last mentioned plate at the back of the main plate will, therefore, cause the segments to approach or recede from the centre. The cutting is effected by a cutter attached by proper fixtures to one of the segments.

Claim.—"What I claim as of my invention, and desire to secure by letters patent, is the cutter in combination with the movable segments, and these thus combined in combination with the eccentric grooves in the plate, for the purpose, and in the manner, described."

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5. For an improvement in the *Key for Extracting Teeth;* Moses J. Hill, Bloomfield, Lagrange county, Indiana, June 7.

This patent is granted, as stated in the claim, "for combining a friction roller with the bolster of the ordinary key for extracting teeth, in such a manner as that said friction roller shall constitute the bearing part of the bolster in the operation of extracting a tooth."

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6. For an improvement in the *Saw Mill;* James B. Lowry and Philander Eggleston, the former of North East, Erie county, Pennsylvania, and the latter of Mayville, Chatauque county, New York, June 11.

This patent is for an alleged improvement on that kind of saw mills

in which two saws are used; but instead of being strained in a gate, they are attached to chains that are connected with two vibrating beams, the ends of which are segments of circles. The claim is confined to the combination of a slide and stirrup, by which the saws are attached to the chains, and by which they are guided.

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7. For an improved mode of *Fastening Doors on the inside*, called the "Traveler's Security;" Benjamin H. Green, Princeton, Mercer county, New Jersey, June 11.

This instrument is for fastening doors from the inside which are not provided with locks or bolts. Two claw pieces, one of which is put against the floor, and the other against the lower rail of the door, are united together by a right and left handed screw, provided with a thumb piece in the middle for turning it, and by which the claws are forced apart.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the traveler's security by combining the two claw pieces with an intermediate screw, furnished with a thumb piece for turning the same, as described."

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8. For an improvement in the *Bee Hive;* James Le Pataurel, Chandlersville, Muskingham county, Ohio, June 11.

The proposed improvement is in that kind of hive in which the honey is formed in glasses, and by which the patentee says he is "enabled to take out the honey, &c., from the hive, without destroying the bees, and without running any risk of being injured by them." The glasses are made with a stem which fits a hole in the cover of the hive, and are provided with a hole at top, and they are arranged in pairs at a suitable distance apart, to receive two pipes that branch out from a furnace for generating smoke. When it is desired to drive the bees from a set of glasses into the apartment below, the pipes are applied to the glasses, and a composition, consisting of 3 oz. of sulphur, 4 oz. of pitch or tar, 1½ oz. of tobacco, and ¼ oz. of grease, is put into the furnace, which generates a smoke that expels the bees. The glasses are then removed, and the holes closed by means of movable covers. When it is desired to drive the bees from one apartment to another, the pipes of the furnace are introduced through holes in the cover of that apartment from which they are to be driven.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the manner in which the glass bows, or hives, are combined and adapted to the apertures in the cover, by being formed with hollow stems, as set forth. I also claim the furnace constructed and combined with the hive, as set forth."

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9. For improvements in *Door Locks and Latches;* Geo. W. Wilson, Nashua, Hillsborough county, New Hampshire, June 11.

The claim in this patent rests upon the making of the lever, which acts upon the latch, with a heavy weight and disconnected from the

latch, so as to cause it and the knobs to return to a stationary position, and thereby, whenever the door is closed, to permit the latch to recede and advance independently of said lever; and also to the combination of this with a weighted, or gravitating, latch; to the combining with the main bolt of the lock another bolt, to be operated by an extra key; and to constructing the holding lever of the main bolt so that the key cannot be withdrawn unless the holding lever has been brought to its proper place; and, finally, to a peculiar apparatus for giving an alarm should any one attempt to open the lock; this apparatus consists of a slide, spring, and spring catch, to be used in connexion with the extra bolt, and which, when disconnected therefrom, starts the alarm.

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10. For improvements in the *Horse Power;* Samuel H. Little, Gettysburg, Adams county, Pennsylvania, June 10.

The patentee informs us that the improvements consist in the "manner of constructing this machine, by which it is made capable of being adapted to the power of two or four, or any other varying number of horses." The rim of the main driving wheel, with the cogs thereon, is cast separately from the arms, by which it is connected to the shaft, there being gains, or notches, cast in the inner side of said rim, into which the ends of the arms fit, and by which it is capable of being removed from one set of arms, and placed upon another set, of the same size. Immediately over the arms above named, and connected with them, are the sunken troughs which receive the horse sweeps. The weight of the wheel, arms, &c., is supported by conical friction rollers, which have their bearings in braces cast with the said arms. This wheel revolves on a stationary pivot rising from the cap of the machine, and gears into a pinion on the shaft of the second wheel. The upper ends of the shafts of the second and third wheels are adapted to receive the main wheel when it is desired to employ less power. The lower gudgeon of the shaft of the second wheel is received in the upper part of a standard projecting from the bed of the machine; and this standard is also adapted to the reception of a shaft, instead of this, provided at its upper end with arms and troughs for the horse sweeps; and at its lower end with arms for the main wheel; the said arms being also provided with conical friction rollers that travel on the upper part of the standard, which is made conical for that purpose. By these various arrangements this machine may be conveniently and readily adapted to the power of one, two, or more, horses.

The claim makes reference to the drawings, and is to the manner in which the cross, or troughs for the sweeps, the arms and rim of the driving wheel, and the friction rollers, are arranged and combined, so that they may be shifted from one shaft to another, and by which the wheel may be adapted to other arms of the same size; and also to the manner of arranging the extra shaft so that it may take the place of the shaft of the second wheel.

11. For improvements in *Marine Steam Engines;* Charles W. Copeland, New York, June 11.

The cylinders, in this arrangement of the engine, are inclined at an angle dependent upon the depth of the hold, and the length of stroke; and they are fastened to inclined beams extending from the paddle-wheel shaft to the kelsons, said beams being connected with the kelsons along their whole length, by other beams, and by bolts—the whole constituting truss-frames, which sustain and divide the weight and jar of the engines. The condensers are directly under the upper end of the cylinders, and the channel-plates run between the kelsons. The lower end of the air pumps, which are inclined, as well as the cylinders, are secured to the ends of the said channel-plates, and the hot wells to their upper parts; the delivery valves are placed on the upper side of the channel-plates. The pistons of the air pumps, in this arrangement, are solid; and the whole apparatus is rendered compact, and placed within the reach of the engineer. The side pipes are placed above the cylinders, the steam chests at each end thereof, and the valve stems running down in front of the heads of the cylinder to the rock shaft. The feet are attached directly to the stems, instead of lifting rods, and are acted upon by the toes of the rock shafts, the two rock shafts being connected together by a rod.

Claim.—"What I claim as new, and as constituting my invention, is, first, the placing of the cylinder in an oblique direction, with its lower end near to the bottom of the vessel, and allowing it to stand at such angle as is required for the connecting of its piston rod with the crank on the shaft of the paddle wheels, in combination with the condenser, channel-plate, and air pump, arranged and located as described. I do not claim the mere placing of the cylinder of a steam engine obliquely, as this has been done for other purposes; but as I produce a new and useful effect, by so placing the steam cylinder and its appendages in the combination above claimed, on board of vessels for navigating the ocean, I limit my claim to the so placing them under the said combination as to attain the object fully made known. Secondly, I claim the manner of arranging and working the steam and exhaust valves as set forth, the same being effected by a direct action, that is to say, without the employment of the lifting rods and lifters usually required for that purpose. Thirdly, I claim the manner of combining and arranging the condensing apparatus, the air pump being placed at the same angle, or nearly so, with the cylinder, and attached by its lower end to the channel-plate, the delivery valve being also placed on the upper part of the said plate; the combination intended to be claimed under the last head consisting in the arranging of the several parts enumerated, that is to say, the air pump, the channel-plate, and the delivery valve, substantially in the way described."

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12. For an improvement in the *Fulling Mill;* Sidney E. Coleman, West Haven, Rutland county, Vermont, June 11.

The cloth is put into the machine, with the usual folds, and passes

between rollers arranged in a box, which have different degrees of motion communicated to them by band wheels and bands, or by cogged wheels.

Claim.—"I claim as my invention, fulling cloth by means of revolving rollers, or cylinders, said rollers being arranged in a box, or casing, and operating as described."

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13. For an improvement in the *Saw Mill;* William Bryant, Nashville, Tennessee, June 11.

The saw gate and fender posts of this mill are placed at an angle of about 45 degrees with the plane of the carriage, instead of being perpendicular to it.

Claim.—"What I claim as my invention is, placing the guides which direct the saw at such an angle with the log, or timber to be sawed, that the shavings in being cut are peeled, or raised, and carried forward by the teeth of the saw, in the lengthwise direction of the timber sawed."

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14. For an improvement in the *Rotary Steam Engine;* Hernon Smith, Sunbury, Delaware county, Ohio, June 11.

In this rotary engine there are two pistons on opposite sides of the wheel, or drum, each being united by a rod passing through the diameter of the wheel, said rod being provided with a loop in the middle, to pass over, and slide on, the shaft. This double piston is operated, or shifted, during the rotation of the wheel, by means of a cam on its outside, which cam is a semi-circle, with the ends running out from the circle to catch a pin on the piston, and thus shift it.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the peculiar form and construction of the double piston moving over the shaft, in combination with the semicircular cam outside the steam chamber, as described, for changing the position of the pistons as the wheel revolves."

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15. For an improvement in the *Lamp for burning Oil and Camphine;* Christian and Charles Richman, Philadelphia, Pennsylvania, June 11.

The wick tube of this lamp, which is on the principle of the Argand, is provided with two holders that are jointed to the lower end of the tube, their upper ends being semi-circular, and made to hold the wick against the upper end of said tube. This holder slides on the inner cylinder of the lamp, a pin on its inner side passing into a groove on the outside of the cylinder; and on the outside of the holder is placed the runner, which has a spiral groove running from its upper end to near the bottom, into which fits a pin from the wick holder, so that by turning the runner the wick holder will be made to rise or sink vertically. The upper end of the runner is connected with the glass holder. The button is made conical and of glass, instead of being flat and of metal.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manner in which we have combined the wick tube with the runner and internal cylinder, which is to say, we claim constructing the runner with a spiral, as set forth, in combination with the internal cylinder having a vertical groove and the wick tube arranged between them, by the combined action of which revolving spiral and stationary groove, the wick tube and wick are raised without being turned, as in the ordinary astral lamps. We also claim the manner in which we have combined the clasps with the wick tube, by forming it into two parts, and connecting them by hinges to the bottom of the tube, as set forth. Lastly, we claim the employment of a conical glass button in lamps for burning camphine and other oils."

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16. For an improved *Apparatus for, and mode of, Feeding Silk Worms;* Edmund Morris, Burlington, New Jersey, June 16.

The feeding frames are made of strips of wood, arranged at proper distances apart in a frame, the two hind corners of which fit into grooves made in the sides of two uprights; about twelve inches above each frame is placed the roof, consisting of a frame with cords stretched across it, to sustain a layer of straw, and a cover, to catch the dirt which falls from the feeding frame, which stands three inches above it. In this manner the feeding frames and roofs are arranged one above the other. A fork is used, called a "cleaner," for the purpose of lifting the material on which the worms have been feeding; this cleaner consists of a bar, provided with two handles, one near each end, and ten or more prongs.

Claim.—"I claim the manner of constructing the above described apparatus, or frame, for feeding silk worms—that is to say, I claim the combining together of a series of feeding frames and of roofs, by sliding the end pieces of the same, extended out for that purpose, into grooves made in uprights, which may extend from the floor to the ceiling of the room; said feeding frames and roofs having such uprights at their backs only, and forming a continuous and unobstructed range in front of them, along the whole, or any desired portion, of the apartment, without the intervention of uprights, or supports of any kind, so as to admit of the operations of feeding and cleaning being carried on with perfect facility, the respective parts being arranged and combined substantially as set forth. I claim the method of cleaning the worms, when necessary, by the employment of the cleaning fork described, by which I lift at once the entire surface on which the worms may be feeding, so as to clean them without waiting, as the practice has been, for the worms themselves to mount up into fresh foliage, and so as to allow the mass, stems, and foliage, to be promptly removed. I claim the within described manner of forming the portable straw spinning roof, in which the worms are to form their cocoons, and by the portability of which I am enabled to identify the age, from the spinning, of any number of cocoons, the gathering of which is thereby greatly facilitated, while their value is not endan-

gered by being kept too long ungathered; the said spinning roof serving the double purpose of catching the litter from above as it falls from the frame, and of affording a suitable place for the worms to spin in as they rise from the frame below."

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17. For an improvement in the *Spark Arrester*, for the Chimnies of Locomotives, and other Steam Engines; Richard French, Philadelphia, Pennsylvania, June 16.

The chimney is surmounted by a concave cap, placed a short distance above its upper end, sufficient room being left for the draught. The whole is surrounded by an outer casing, which forms a receptacle for the sparks which are thrown down by the cap. The top of this outer casing is formed of perforated concentric sheets, or hoops, of metal, arranged as expressed in the claim, which is in the following words, viz:

"What I claim, and desire to secure by letters patent, is the manner described of arranging and combining the hoops, or bands, of perforated sheet metal, or of wire gauze, by uniting them at their upper and lower edges, alternately, so as to produce continuous perforated surfaces of great extent; between which surfaces concentric circular spaces are left when the instrument is made circular, as is usually done. I also claim the combining with the foregoing apparatus oi perforated hoops, bands, or plates, a disk, or cap, interposed between the top of the chimney and said system of perforated hoops, or bands, for the purpose made known."

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18. For improvements in the *Plough;* David Prouty and John Mears Boston, Massachusetts, June 16.

These improvements are for a mode of uniting a double reversible point, or nose, with the share, or wing, and the two with the mouldboard, in the manner expressed in the claim, which follows, viz:

Claim.—"First, we claim arranging, or connecting, the invertible nose and ring together, by means of suitable grooves on the side of the former, and the corresponding angular, or wedge-shaped, sides of the latter, fitting into the grooves as described; and we also claim imbedding the invertible wing and nose, or point, upon the mouldboard, and confining them in their positions by means of a cap, having projections and grooves corresponding with those of the said invertible parts; the cap being rebated to the plough share, so as to have its upper face a continuation of the curved surface of the same; the whole being confined together by a bolt, or bolts, and nuts, as described."

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19. For an improvement in the *Grates of Cotton Gins;* Albert Washburn, Bridgewater, Plymouth county, Massachusetts, June 16.

This improvement is intended to obviate the necessity of renewing the grates of cotton gins in consequence of the wear which takes

place at the part where the saw teeth pass, by making a dovetail groove to receive a piece of metal, glass, or hard wood, which may be taken out when worn, and renewed without the necessity of even moving the grate.

The claim is confined to this manner of construction.

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20. For an improvement in the machine for *Trimming Books, Cutting Paper, &c.;* Frederick J. Austin, New York city, June 16.

The books, or paper, to be cut or trimmed, are secured in a press of the usual construction; and the knife by which the cutting is effected receives a double motion, which causes it to give a drawing cut, thereby cutting more smoothly and easily than if the cut were directly vertical. The knife is attached to a frame, which is provided with what the patentee calls "inclines, or cams," which slide against similar cams attached to the frame of the machine. This knife frame is connected by means of two jointed connecting rods, with a vertical sliding frame at the bottom, that receives motion from two pinions on an arbor, the teeth of which take into the teeth of two racks attached to the frame. As the lower sliding frame moves down, it draws with it the knife frame, which at the same time receives a lateral movement by the inclined ways, or cams, at the side.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar mechanical combination used to give a lateral, or sliding, motion to the knife, which consists of the inclines, or cams, formed on the knife frame working on the cams attached to the frame of the machine, the connecting rods, and the lower sliding frame, for the purpose, and in the manner, specified. Also, I claim the mechanical construction of the press, as arranged and combined with the parts for cutting, thereby forming an entire machine for the purpose described."

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21. For an improvement on his *Self-acting Log Brace for Saw Mills;* Benjamin Cushwa, Clear Spring, Washington county, Maryland, June 19.

This improvement is added to a patent granted to Mr. Cushwa on the 15th of July, 1840, and noticed in this Journal, vol ii, 3rd series, page 203.

The improvement claimed is, for the addition of a ferrule with a flanch on to the roller of the log brace, which supports the log, as previously patented; which ferrule and flanch may slide on the said roller, and be set nearer to, or farther from, the line of the saw. The object of this improvement is to prevent the springing of the log—an effect which generally takes place after a slab has been cut from it.

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22. For an improvement in the process of *Burning Lime;* Samuel Garber and Henry Swartzengrover, borough of Norristown, Montgomery county, Pennsylvania, June 19.

The improvement above referred to, is added to a patent granted

to the same persons, on the 25th of March, 1837, and is fully explained in the following claim, viz:—"We claim as our improvement in the calcination, or burning, of lime, the introduction of heated air into a lime kiln, for the purpose of burning or calcining the lime contained therein; and this we claim by whatever means the air may be heated, and whether the lime is or is not intermingled with fuel in the kiln."

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23. For an improvement in the *Slides of Extension Tables;* Charles F. Hobe, city of New York, June 22.

The slides in these improved extension tables are to be plated with metal, and arranged in such manner as to give a longer bearing than is attained by means of the common dovetail slides. Each side of a slide is grooved for about two-thirds its length, the groove commencing on the two sides at opposite ends. These grooves are covered with plates, having slots in them, running nearly the whole length. On each side of the slide, and at that end of it which is not occupied by the slots, there is a T shaped piece of metal, which slides in the slot of the adjoining slides. The slots are enlarged at one end, to admit the T shaped piece, and this enlargement is then closed by a piece of metal which is held by a screw. By this arrangement, each side of each slide is connected with the adjoining slide, in two places, its T piece on one end, fitting into the slot of an adjusting slide, and a slot on the other end receiving the T piece from the adjoining slide; the same connexion being repeated on each adjoining slide.

The claim to the foregoing arrangement refers throughout to the drawings.

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24. For a new *Composition for Coating Metals, to prevent Corrosion;* Arthur Wall, Shadwell, England, June 22.

(See Specification.)

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25. For improvements in the *Washing Machine;* H. R. Walter, Norwich, Chenango county, New York, June 22.

In this washing machine "the clothes to be washed are placed upon a fluted board, which lies horizontally within a trough, or cistern, containing the suds, or water, by which the cleansing is to be effected. Over this board, and upon the clothes laid upon it, a fluted roller is to be passed back and forth, which roller revolves in suitable head-blocks, and is pressed down by the action of spiral springs, so as to enable it to yield to the inequality of thickness in the articles to be washed. The roller is surmounted on its upper side by a plate of sheet metal, which extends from one head-block to the other, and with them constitutes a frame for containing the fluted roller. This fluted roller frame is held down, as it traverses back and forth, by guide pieces attached to the sides of the cistern, and which enter into grooves made on each end of the frame to receive them."

Claim.—"What I claim is the manner in which I have constructed the fluted roller frame, and combined the same with the trough, or

cistern, as herein set forth; that is to say, I claim the arranging of the fluted roller so that its gudgeons shall be received in sliding rods, which are acted upon by spiral springs contained in two head-blocks, are connected together by a cap, or covering, which incloses the fluted roller; the whole being constructed substantially in the manner described. I claim, also, the combining of the said fluted roller frame with the cistern, by means of ledges attached to said cistern, and received within grooves on the head-blocks, said grooves being furnished with friction rollers on their lower sides, and the roller frame being made to work back and forth horizontally, upon a horizontal wash board, for the purpose, and in the manner, described."

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26. For an improvement in the *Water Wheel* for Mills; Nelson Johnson, Triangle, Broome county, New York, June 22.

The patentee calls this an "improved direct percussion and reaction water wheel," that is to say, the wheel is to be actuated by the striking of the water upon the buckets, aided by the reaction as the water leaves them at the bottom. The outer rim of this wheel is conical, with a flanch curving outward at the lower edge, and the inner rim is in the form of the lower section of a bell. These two rims are connected together by curved buckets, the outer rim being scolloped, to correspond with the upper, inclined, curved surface of the buckets. The inner rim is lower than the outer, so that the buckets incline downwards, towards the shaft, as well as in the direction of the circumference.

"What I claim as my invention is the manner in which I have combined the buckets with the inner bell-shaped rim, and outer conical rim, by forming the scollops in the upper edge of said outer rim where the water enters, instead of in the lower edge of said rim, where it discharges, as in my original improvement; and combining one edge of the buckets with the scollops thus arranged, and the other with the inner bell-shaped rim, as set forth."

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27. For an improved mode of *Setting up Printing Types;* James Hadden Young, of England, and Adrain Delcambre, of France, June 22.

This invention consists in a machine, or apparatus, for what is technically called composing, or the setting up, of types for the purpose of printing; by its means the letters are to be placed in their proper order, as in the composing stick, in a much more rapid manner than heretofore; this is effected by means of an inclined plane, or inclined planes, upon which the types are thrown, and allowed to descend by various channels, which meet in one point, at the composing box, which supplies the place of the ordinary composing stick. There are a number of keys, somewhat similar to those of a piano forte, which act upon levers that push the types on to the inclined plane, or planes, down which they descend by their own gravity, to the said box, whenever the keys are depressed; such types being so pushed out of

boxes, or cases, made to contain them. The types are arranged in the composing box side by side, and then removed by hand to the chase, in the usual way.

There is a groove for each letter of the alphabet, the entrance to which is governed by what is called a pushing frame, in connexion with a key having a corresponding letter marked upon it. These grooves are all arranged side by side on the inclined plane, and are covered by a covering plate, to prevent the types from jumping out. The types are arranged in cases, consisting of inclined channels, and each channel is in connexion with an appropriate groove, and when the proper key is acted upon, the pushing frame forces the lowest letter out of the channel into the groove, down which it descends to an aperture, provided with a spout, which insures the proper delivery of the letter in the composing box; and at the reception of each letter, a combination of levers, acted upon by the keys, causes all the former letters to be pushed forward for the reception of the next.

Claim.—"We hereby declare the inclined plane, the pushing frame, the covering plate, our new composing box, and the movements connected with the said box, to constitute our said invention, for which we hereby claim to maintain exclusive right and privilege, by means of letters patent.

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28. For an improvement in the *Lamp for Burning Lard;* Edward T. Williams and Latham T. Tew, Newport, Rhode Island, June 26.

The body of the lamp, or stand, is cylindrical, and within it a piston is fitted, for the purpose of forcing the lard up to the wick. Two screws pass through the said piston, and extend down to the base of the lamp, and are each provided with a pinion, the teeth of which take into the teeth of a small cog wheel, which has an axle adapted to the reception of a key fitting into it from the under side of the base, or stand. Under this arrangement, the turning of the key will actuate the screws, and thus work the piston up or down.

The claim is to the method of feeding the lamp, or elevating the lard into the reservoir which contains the wick, by means of a movable piston in the tube, or neck, of the lamp, arranged and operated in the manner described.

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29. For an improvement in the *Spark Arrester* for Locomotive and other chimneys; Leonard Phleger, Philadelphia, Pennsylvania, Assignee of W. W. Hubbell, Moyamensing, Philadelphia county, Pennsylvania, June 26.

In this apparatus, the spark arrester and the receptacle for the sparks, instead of surrounding the chimney as usual, is placed alongside of it, and they are made to communicate with each other at, or near, the top—the latter being of greater diameter than the former. Within the tube of the spark arrester there is a perforated tube of less diameter and length, so as to leave a space all around, between the

two, and at the bottom. The perforated tube, where the arrester receives the draught, smoke, sparks, &c., is covered with solid sheet metal, for the purpose of scattering the sparks. The top of the chimney is provided with a cap, which may be removed whenever it is not desired to make use of the arrester. The space between the outer and the inner perforated tube is covered, so that the draught must pass through the perforations in the inner tube, the sparks being retained in the space between the two.

By this arrangement, we are told by the patentee, that "the chimney is not rendered top-heavy, a less surface than usual is exposed to the action of the wind; advantage is also derived from the large surface of the casing which is exposed to the action of the external air, which condenses a portion of the exhaust steam which is passed into the chimney as usual, and is forced along with the sparks, into the space between the outer and inner tubes."

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the chimney and the spark arrester and depositor; the chimney not being surrounded in any part by the arrester, but the two being placed side by side, and communicating with each other at their upper ends; and the arrester and depositor consisting of an outer case, an inner perforated, or wire gauze, cylinder, or tube, with an imperforated part where the draught first strikes it; and having a receptacle for cinders and ashes at its lower end, as described."

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30. For an improvement in the *Spark Arrester* for Locomotive and other chimneys; Leonard Phleger, Philadelphia, Pennsylvania, Assignee of W. W. Hubbell, Moyamensing, Philadelphia county, Pennsylvania, June 26.

The chimney, in this arrester, is surrounded by a perforated cylinder, and the whole by a jacket, which extends down lower than the said perforated cylinder, but not quite so low as the chimney. The chimney is provided with a movable cap, as described in the preceding notice; and the space between the perforated cylinder and jacket is permanently covered with a cap. Near the top, the chimney communicates with the outer space, by means of pipes that pass through the perforated cylinder, so that the draught passes from the chimney into the outer space, and thence, through the perforations in the cylinder, into the space between the chimney and perforated cylinder, and out at the top.

Claim.—"I hereby declare that I do not claim to be the first inventor of either of the separate parts thereof individully, but I do claim to have so combined and arranged these parts as to have produced an instrument substantially new in its character, and beneficial in its effects; that is to say, I claim the surrounding of the chimney by the perforated metallic cylinder, or cone, and the jacket, or case, combining these parts together, and inclosing them in the manner set forth; the chimney being furnished with a cover, or shutter, and tubes, or pipes, of communication extending from said chimney into the outer

space; and the other parts concerned in the action of the apparatus, being arranged substantially in the manner, and so as to produce the results, set forth."

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31. For an improvement in the *Spark Arrester,* or Depositor; Leonard Phleger, Philadelphia, Pennsylvania, Assignee of W. W. Hubbell, Moyamensing, Philadelphia, Pennsylvania, June 26.

In this instrument, the smoke box is surmounted by a drum, and upon this is placed the chimney, which is connected with it by means of a hinge, to admit of passing under bridges, &c. Within the drum is placed a cylinder of perforated metal, or wire gauze, which is closed at its lower end by a plate of solid metal, with a hole in the middle, surrounded by a flanch projecting downwards, for the reception of the exhaust steam pipes, the upper end of the said cylinder being left open. Within the drum there is a belt, or zone, of perforated metal, or wire gauze, united with it at its lower end, and which extends up conically and is united with the upper end of the perforated cylinder, by an annular plate which closes the space between the two. In the space between the perforated cylinder and zone, there is an imperforated casing, or tube, which extends from within a short distance of their upper ends, to the top of the fire box, a part of it being within, and the rest below the drum, the lower end of which is inclined and connected with the said case by an annular plate, that forms an inclined plane, to cause the sparks which fall upon it to descend into a box at the side. There is an inclined pipe which runs down from the inclined lower end of the drum to the box or receptacle for the sparks; this pipe is divided into two parts by a perforated diaphragm, extending its length, and dividing it into an upper and lower space; the upper space being connected with the upper part of the drum by a pipe. Within the perforated cylinder is an imperforated tube, open at both ends, (and supported by stays,) for the purpose of directing the exhaust steam immediately up the chimney, and to prevent it, by its expansion, from impeding the passage of the draught through the perforations in the cylinder.

Claim.—"What I claim as new, and desire to secure by letters patent, is the particular manner in which I have combined and arranged the respective parts, as set forth; that is to say, I claim, in combination, the perforated cylinder, and the perforated belt, or zone, connected with each other by means of an imperforated annular plate, the lower edge of the zone being connected to the drum, as described and represented. I also claim, in combination with each other, the arranging of the inclined annular plate of metal, the tube leading to the box, the perforated diaphragm, and the tube, so as to conduct and deposit the sparks in the box, whilst that portion of the draught which accompanied them and forced them down, is allowed to escape into the chimney, as described."

32. For a *Horizontal Spark Arrester* for Locomotive and other chimneys; Leonard Phleger, Philadelphia, Assignee of W. W. Hubbell, Moyamensing, Philadelphia county, Pennsylvania, June 26.

The patentee says:—"I have combined a horizontal spark arrester and flue with a vertical chimney, which chimney may, in most cases, be made so short as not to require to be turned down, but which may, if desired, be attached to the part constituting the arrester by a hinged joint, and may then be turned down with facility. The horizontal flue that is combined with the spark arrester may be considered as constituting a part thereof, and it is likewise to be considered as forming a part of the chimney; this horizontal flue I sometimes surround by the perforated sheet metal, or wire gauze, by which the sparks are to be arrested."

Claim.—"What I claim, and desire to secure by letters patent, is the combining of a spark arrester, placed in a horizontal position, with a vertical chimney, substantially in the manner set forth, for the purpose of obtaining the necessary length of flue, and of perforated metallic surface for the proper action of the instrument, whilst the vertical chimney itself may be so short as to pass under the lowest bridges upon railroads."

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33. For *Railroad Alarm Signals;* Samuel Nicolson, Boston, Massachusetts, June 26.

There is a curved lever jointed to the track, (the curved surface projecting above the rail,) and connected by bell cranks and wires passing under the track, to an alarm bell elevated to a considerable height, and worked by a weight, in the usual manner. When the wheels of the tender pass over the curved lever, it is pressed down, which communicates with, and starts, the alarm.

Claim.—"I claim as my invention, and desire to secure by letters patent, the method of communicating motion to the alarm, by the passing of the wheels of the tender, &c., over the curved lever connected with the alarm, in the manner specified."

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34. For an improvement in *Casting Composition Screws;* John Luther, Warren, Bristol county, Rhode Island, June 26.

This patent is for making screws with the head and shank of brass, iron, or other hard metal, and for casting thereon a body and threads of soft metal or composition. Into a mould of the form of the intended screw, the soft metal, or composition, is poured, and the hard metal shank, which must be previously tinned, is then inserted, thus causing the soft metal, or alloy, to adhere to the tinned surface of the shank.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making cast screws with iron, brass, or copper heads and shanks, whilst the body and thread are made of tin, lead, zinc, antimony, or any soft metal, or any of these combined."

35. For an improvement in the *Machine for Hulling Rice,* and any other kind of Grain; Webster Herrick, Northampton, Hampshire county, Massachusetts, June 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of two disks, covered with pointed wires, or with stout card teeth, one of which disks is made to revolve vertically within a drum, and is borne up against a stationary disk, similarly armed, by means of a spiral spring pressing against its shaft, and regulated by a tempering screw; and having combined therewith an iron centre plate, or disk, provided with projecting ribs," (for the purpose of throwing the grain towards the wire rubbers,) "in the manner described."

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36. For an improvement in the manner of *Constructing Wheels for Rail and other Roads;* Henry Dircks, Liverpool, England, June 26.

This wheel is formed with a groove, or channel, into which is filted blocks of wood, with the grain running radially, and bolted to the iron, as a substitute for the iron tread.

Claim.—"I claim the combination of a metallic wheel with a wooden faced tire, or tread, as before described, without being confined to its precise mode of construction, or putting together."

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37. For an improvement in the *Floating Dry Dock,* for raising vessels; John Thomas, New York, June 26.

This improved floating dry dock is of the kind which is made in sections, with floats at each end, for the purpose of assisting the main float in raising the vessel, and to prevent the whole from rocking. Each section consists of a truss frame, on which the vessel rests, and at each end it is provided with a large float, which is made to slide up and down in a frame, by means of screws with double right and left handed threads, which act upon nuts in two sets of followers. There are tongue pieces with key holes along their length, attached to the floats, which pass through mortises in the followers. The turning of the screws causes the followers to approach towards, or to recede from, each other, simultaneously. The advantage of this device is, that as one follower is lifting up, or forcing down, the float, by having the tongue piece keyed to it, the other is returning to the proper place for commencing action when it shall have reached the limit of its play, instead of using but one follower, which requires the operation to be arrested whilst it is returned to its place, or else em ploying a screw of the whole length of the play of the float.

"I am aware that end floats have been used in floating dry docks for the double purpose of preserving the equilibrium of the dock, and to assist the main floats in the body of the dock, in raising the vessel and frame; the main floats being sunk by admitting water into them, and then by pumping it out, and therefore I do not claim merely the use of end floats, or dispensing with the inner, or main, floats, as

made known, and used; but what I do claim as my invention, and desire to secure by letters patent, is the employment of movable end floats of sufficient capacity to raise the vessel, or vessels, and dock, by forcing them down by mechanical force, when used without the the inner, or main, floats employed heretofore, for the purpose, and in manner described. I also claim the combination of the right and left handed screws, followers, tongue pieces, and movable floats, for the purpose, and in the manner, described."

Specifications of American Patents.

Specification of a patent granted to Arthur Wall, *of Shadwell, Great Britain, for a composition for preventing Corrosion in Metals, June 22d,* 1841.

Be it known that I, Arthur Wall, of Shadwell, in the county of Middlesex, in that part of the kingdom of Great Britain called England, surgeon, have invented a new composition for the prevention of corrosion in metals; and I do hereby declare that the following is a full and exact description of it. To enable others skilled in the art to use my invention, I will proceed to describe the mode of manufacturing the same, and the application thereof. I place twenty pounds of the strongest muriatic acid, diluted with three gallons of water, in a shallow pan, or vessel, made of cast iron. I then take 112 pounds of filings of either steel or bar iron, or other wrought iron; I heat them to redness and throw them into the mixture of acid and water, for the purpose of oxidizing the filings. I then place the pan on a sand bath, (heated by a flue from a furnace,) which digests the filings, and facilitates the oxidation. I repeatedly stir up the whole, and after subjecting them to this process for about twenty-four hours, or until ebullition takes place, and the greater part of the filings are taken up by the liquor, or mixture, I allow the oxides thus obtained, to run off through a tap into a vessel beneath, leaving the metal not operated upon at the bottom. When these oxides are quite settled, the clear mixture, or liquor, is run off from them into a third vessel, and then the filings must be subjected to the same process in the original mixture, to complete the oxidation, (that is,) they must be again made red hot, and the mixture which has run into the third vessel thrown upon them, and this process must be repeated until all the filings have oxidized that can be made to do so. The oxides thus obtained I now expose on an iron plate, made red hot over a furnace, until all moisture has evaporated from them, and they assume a red appearance. I then mix with them sixteen pounds of quicksilver, by sifting it through a very fine wire sieve on to the oxides, and afterwards I intimately mix it with them by rubbing the whole down in a mortar, or other suitable process, and when so mixed I then add as much water as will cover the surface, and from eight to nine pounds of strong nitric, or nitrous, acid, and again place the whole on the furnace plate, or iron bath, and repeatedly stir it until all the

menstruum, or liquor, has nearly, or completely, evaporated. I then place the whole mass in a mortar, or other pounding machine, and bray, or pound, it until it is in a complete state of blackness. I then mix it with water, and stir, or wash, it until all the light particles are washed out. I then allow it to settle, and when the settlement has taken place, the water is poured off from the sediment at the bottom. This sediment I then place in a crucible, or earthen retort, with a receiver attached, adapted for the reception of any chloride, or mercury, that may escape, or come over, (the contents of this receiver I preserve, in order to re-add to the general mass afterwards, when cool;) then I make it red hot, and when in this state I plunge it into fresh boiling water, and stir it for a few minutes, and then allow it to settle. I then pour the water off, let it cool, and add the chloride, as before stated; and after the last mentioned process, I add to it one-quarter of its own weight of common black lead, or minium, commonly called "red lead," according to the color which the operator wishes the composition to assume. Previously to applying this composition to metal, I add to it such a quantity of boiled linseed oil and spirit of turpentine, (in the proportion of one-fifth of spirit of turpentine to the oil used,) as will reduce it to a state sufficiently liquid to be spread with a brush. This preparation I then apply as thinly as possible, by means of a brush, to sheets of copper, or other metal; which sheets I afterwards subject to a heat gradually raised to about 300 degrees of Fahrenheit's thermometer, so as to make the metal imbibe the preparation; this heat must be applied to the sheets of prepared metal, without smoke or flame, by placing the sheets on trucks in contact with the flue plates, in the manner hereinafter described. The mode of applying this heat may be various, but in order the more distinctly to explain my meaning, and likewise my mode of operating, I shall now proceed to describe the furnace which I use, and find to answer the purpose. I erect two or more horizontal flues, the construction and dimensions of which may be varied according to circumstances, which flues should gradually decline towards the extreme end from the furnace bars, so as to produce a good draught and communicate a stronger heat to the plates above next mentioned. These flues I cover with cast iron plates. I then raise the exterior walls of the furnace to the height of from about three to six feet above the iron plates, which walls must be bound with iron braces to prevent them from cracking, from the excessive heat. I then place thin sheets of iron slightly curved, thus forming a roof, and rest them on the exterior wall. Each end of the chamber (thus formed) is closed by an iron plate, made to slide up and down by a pulley, so as to act as a damper, and let out, or confine, the heat. The heat from the flues is carried away by a common chimney, which has a damper in it for the purpose of controlling the heat. The sheets of metal prepared with the composition as above described, are thus placed upon iron trucks, between upright pins which run on wheels of four inches in diameter, and are thus placed over the iron plates made hot by the flues; the heat must be gradually applied to prevent the composition from blistering on the metal, by the trucks being first

placed at the extreme end from the furnace bars, and gradually rolled over the flue till evaporation ceases, and the metal assumes a dark appearance—this completes the operation. When preparing iron tanks with the composition, I apply the furnace heat merely sufficient at first to expel the moisture from the metal, and when in that state I take them out and sprinkle over them as much charcoal, very finely pounded, as will be absorbed by the metal, which gives to the metal, when prepared, a glossy appearance. I then apply the stronger heat, and the operation is completed.

Now, I do not claim as any part of my said invention any of the separate processes, or the use of any vessels or furnaces. But what I do claim as my invention, and desire to secure by letters patent, is the composition prepared as above described, for the prevention of corrosion in metal and for other purposes.

Crane's Anthracite Iron.

Decision of the Court of Common Pleas, affirming the validity of the Patent granted to George Crane, Esq., for Smelting Iron with Anthracite Coal. Delivered at Westminster Hall, June 13th, 1842, by Lord Chief Justice Tindall.

The Lord Chief Justice:—This was an action on the case for the infringement of a patent granted to the plaintiff on the 28th of September, 1836, for an improvement in the manufacture of iron. The declaration was in the usual form, and the defendants pleaded thereto, first, that they were not guilty; secondly, that the plaintiff was not the first and true inventor of the said improvement—upon each of which pleas issue was joined;—thirdly, after setting out at length the plaintiff's specification, the defendants pleaded that the alleged improvement therein described, was not a new manufacture, invented by the plaintiff within the intent and meaning of the statute, as to the public use and exercise thereof in England—which allegation was traversed by the plaintiff in his replication; fourthly, the defendant pleaded that the nature of the plaintiff's invention, and the manner in which it was to be performed, were not particularly described, or ascertained by the plaintiff, in his specification—upon which plea issue was joined; and in their last plea, the defendants, after referring to the plaintiff's specification, before set out in the third plea, stated the grant of letters patent, dated September 11, 1828, to one James Beaumont Neilson, for an improved application of air to produce heat in fires, forges, and furnaces, where bellows and other blowing apparatus were required—that Neilson's invention was the production and application of a hot-air blast, and was in public use with Neilson's license in the smelting and manufacturing of iron from iron-stone, and was the hot-air blast in the plaintiff's specification mentioned—that the plaintiff could not use the hot-air blast mentioned in his specification without Neilson's license, and that he had obtained such license before the grant of his letters patent, and that the using, by the plaintiff, of the hot-air blast, in the smelting of iron from iron-stone,

combined with anthracite or stone-coal, as mentioned in his specification, was a using and imitating of Neilson's invention, whereby the plaintiff's invention was void. The plaintiff replied to this last plea, that Neilson's invention was not the same hot-air blast, and that the machinery and apparatus adapted for the application thereof, mentioned and referred to in the plaintiff's specification, was not, nor was the using by the plaintiff of the invention, as described in his specification, a using and imitating of Neilson's invention, described in Neilson's specification; which allegation is traversed by the defendants in their rejoinder. At the trial before me, a verdict was entered for the plaintiff on all the issues, subject to the opinion of the Court, upon the evidence given at the trial, as contained in a report agreed upon between the parties—the Court being at liberty to draw the same inference from it as a jury might draw. On the argument, it was contended by the defendants, that the verdict ought to be entered for them on each of the issues joined on the record; but as the main question between the parties turns on the third issue, which involves the question whether the invention of the plaintiff is a manufacture within the intent and meaning of the statute of James—that is, whether it is or is not the subject matter of a patent—and as the determination of this issue, in favor of one party or the other, will render the decision of the other issues free from difficulty, the simplest way will be to apply ourselves in the first instance to that question. Now, in order to determine whether the improvement described in the patent is, or is not, a manufacture within the statute, we must, in the first place, ascertain precisely what is the invention claimed by the plaintiff, and then, by the application of some principles admitted and acknowledged in the application of the law relating to patents, and by the authority of decided cases, determine the question in dispute between the parties. The plaintiff describes the object of his invention to be the application of anthracite or stone coal, combined with hot-air blast, in the smelting or manufacture of iron from iron-stone, mine, or ore; and states, distinctly and unequivocally, at the end of his specification, that he does not claim the use of a hot-air blast, separately, as of his invention, when uncombined with the application of anthracite or stone-coal; nor does he claim the application of anthracite or stone-coal, when uncombined with the using of hot-air blast; but that what he claims as his invention, is the application of anthracite or stone-coal, and culm, combined with the using of hot-air blast, in the smelting and manufacture of iron from iron-stone, mine, or ore. And the question, therefore, becomes this—whether, admitting the using of the hot-air blast to have been known before in the manufacture of iron with bituminous coal, and the use of anthracite and stone-coal to have been known before in the manufacture of iron with cold-blast; but that the combination of the two together (the hot-blast and the anthracite) were not known to be combined before in the manufacture of iron, whether such combination can be the subject of a patent? We are of opinion that if the result produced by such a combination, is either a new article, or a better article, or a cheaper article to the public than that produced before by the old method, that such combi-

nation is an invention, or manufacture, intended by the statute, and may well become the subject of a patent. Such an assumed state of facts falls clearly within the principle exemplified by Abbot, Chief Justice, in the case of the King *v.* Wheeler, 2d Barnewall and Adolphus 349, where he is determining what is, or what is not, the subject of a patent—namely, it may perhaps extend to a new process, to be carried on by known implements, or elements, acting upon known substances, and ultimately producing some other known substance, but producing it in a cheaper or more expeditious manner, or a better or more useful kind. And it falls, also, within the doctrine laid down by Lord Eldon, in Hill *v.* Thompson, in 3d Merivale 629—namely, there may be a valid patent for a known combination of materials previously in use, for the same purpose, or even for a new method of applying such materials; but the specification must clearly express that it is in respect of such new combination or application. There are numerous instances of patents which have been granted, where the invention consisted in no more than in the use of things already known, and acting with them in a manner already known, and producing effects already known; but producing those effects so as to be more economically or beneficially enjoyed by the public. It will be sufficient to refer to a few instances, some of which patents have failed on other grounds, but none on the ground that the invention itself was not the subject of a patent. We may first instance Hall's patent for applying the flame of gas to singe off the superfluous fibres of lace, where a flame of oil had been used before for the same purpose; Derosne's patent, in which the invention consisted in filtering the syrup of sugar through a filter, to act with animal charcoal, and charcoal from bituminous schistus, where charcoal had been used before in the filtering of almost every other liquor, except the syrup of sugar; Hill's patent, in 3d Merivale above referred to, for improvements in the smelting and working of iron; there the invention consisted only in the use and application of the slags, or cinders, thrown off by the operation of smelting, which had been previously considered useless, for the production of good and serviceable metal, by the admixture of mine rubbish. Again, Daniel's patent was taken out for improvements in dressing woolen cloth, where the invention consisted in immersing a roll of cloth, manufactured in the usual manner, in hot water. (See the King *v.* Daniel, in Mr. Godson's book on patents, 274.) The only question, therefore, that ought to be considered on the evidence, is—was the iron produced by the combination of the hot-blast and the anthracite, a better or a cheaper article than was produced from the combination of the hot-blast and the bituminous coal; and was the combination described in the specification new, as to the public use thereof, in England? And upon the first point, upon looking at the evidence in the cause, we think there is no doubt that the result of the combination of the hot-blast with the anthracite, on the yield of the furnaces, was more; the nature, properties, and quality of the iron, better; and the expense of making the iron less, than it was under the former process, by means of the combination of the hot-blast with the bituminous coal. It is to be ob-

served, that no evidence was produced on the part of the defendants, to meet that given by the plaintiff on these grounds, and that it was a necessary consequence, from the proof in the cause, that the substitution of the anthracite coal, in whole, or in part, instead of, or in the place of, bituminous coal, from the substitution of that, the manufacture of the iron should be obtained at less expense. It was objected, in the course of the argument, that the quality, or degree, of invention, was so small, that it could not become the subject-matter of a patent; that a person who could procure a license to use the hot-air blast under Neilson's patent, had a full right to apply that blast to coal of any nature whatever, whether bituminous or stone-coal. But we think, if it were necessary to consider the labor, pains, and expense, incurred by the plaintiff in bringing his discovery to perfection, that there is evidence in this cause that the expense was considerable, and the experiments numerous. But in point of law, the labor of thought, or experiments, and the expenditure of money, are not the essential grounds of consideration on which the question, whether the invention is or is not the subject-matter of a patent, ought to depend; for if the invention be new and useful to the public, it is not material whether it be the result of long experiments and profound research, or whether by some sudden and lucky thought, or mere accidental discovery. The case of Monopolies, 11th Coke, states the law to be, that where a man, by his own charge or industry, or by his own wit or invention, brings a new trade into the realm, or any engine tending to the furtherance of a trade, that never was used before, and that was for the good of the realm, that the King may grant him the monopoly of a patent for a reasonable time. If the combination now under consideration be, as we think it is, a manufacture within the statute of James the First, there was abundant evidence in the cause that it had been the great object and desideratum, before the granting of the patent, to smelt iron-stone, by the means of anthracite coal, and that it had never been done before. There is no evidence on the part of the defendants, to meet that which the plaintiff brought forward. These considerations, therefore, enable us to direct that the verdict ought to be entered for the plaintiff, on the third issue; that it was a new manufacture—new as to the public use and exercise thereof, within England and Wales. On the same ground, also, the second issue is disposed of in favor of the plaintiff. No evidence was pro duced, on the part of the defendants, to show any inventor earlier than the plaintiff; nor does the fact that there was an earlier inventor appear, from the cross-examination of the plaintiff's witnesses. As to the first issue—namely, whether the defendants had infringed the patent—we think it clearly appears on the evidence, that the defendants had used, either in part or in whole, the combination described in the specification of the plaintiff's patent; the plaintiff's evidence goes fully to show certain infringements, and that is not met by any explanation on the part of the defendants. Indeed, the defendants' case did not appear to rest on this point, at the trial, so much as on the important question raised by them, whether the improvement described in the specification was a manufacture within the statute of James.

Upon the fourth issue, which raised no more than the usual inquiry —whether the nature of the invention was sufficiently described in the specification?—the usual evidence was given, that persons of competent skill and experience could, by following the direction, produce the manufacture described, with success; and this evidence was entirely unopposed. Upon this issue, also, the verdict ought to be entered for the plaintiff. With respect, however, to the issue raised in the rejoinder, in the plaintiff's replication to the fifth plea, we are of opinion, that taking the whole evidence brought forward by the plaintiff, it is impossible to perceive any substantial or real distinction between the hot-air blast, and the machinery and apparatus described in Neilson's specification, from that described, or referred to, in the plaintiff's; or to say that the using by the plaintiff of the invention described in his specification, was any other than a using and imitating of the invention described in Neilson's specification. The plaintiff, indeed, worked by licence under Neilson's patent, at the time of his discovery. On this fifth issue, therefore, we think the verdict should be entered for the defendants. Then arises the question, whether the plaintiff is or is not entitled to the judgment, notwithstanding the verdict on the fifth issue, on which point the argument on the part of the defendants is, that the taking out a patent for an invention, which invention cannot be used or enjoyed by the public, except by means of the former invention of another person, which former invention is itself the subject-matter of a patent still in force, is void by law. Undoubtedly, if the second patent claims, as part of the invention described in it, that which had been the subject-matter of a patent then in force, it would be void, on the double ground that it claimed that which was not new, (which, indeed, would equally be the case if the former patent had expired;) and also that it would be an infringement of, and inconsistent with, a former grant of the King, still in force; which latter consideration, alone, would make a new grant void. But in this case, there is an express disclaimer of any part of the invention to the use of the hot-air blast, which was covered by Neilson's patent, the specification describing that the application of the hot-air blast was well understood, and extensively applied, in many places where ordinary fuel is employed. The validity, therefore, of the plaintiff's patent cannot be impeached on either of the grounds above adverted to. Unless, therefore, the grantee of the new letters patent is bound by law to specify whether such former invention which is excepted, was so excepted on the ground of its being generally known and used by the public, and on the ground that it was the subject of a patent, that secured the use of it to a former patentee, the new patent will be good; but that distinction is as much in the knowledge of the public as the grantee of the patent. If, indeed, the new patent had been taken out for improvement, or alterations, in an invention secured by a former patent, then, for obvious reasons, greater particularity would be necessary to distinguish the new from the old. But the present specification expressly says—"I take the whole of the invention, already well known to the public, and I combine it with something else." Now, it is fur-

then argued, that in point of law no patent can be taken out which includes the subject-matter of a patent still remaining, or in force. No authority was cited to support this proposition; and the case which was before Lord Tenderden, and in which he held that where an action was brought for improvements in a former patent granted to another person, and still in force, that the plaintiff must produce the former patent and specification; *that* at least affords a strong inference that the second patent was good. *Lewis* v *Davis*, 3d Carrington, and *Payne* and *Harmer* v. *Payne*, 11th East., are clear authorities on the same point; and upon reason and principle there appears to be no objection. The new patent, after the expiration of the old one, will be free from every objection; and whilst the former exists, the new patent can be legally used by the public, by procuring a license from Neilson, or by purchasing the apparatus from him or some of his agents; and the probability of the refusal of a license, to any one applying for it, is so extremely remote, that it cannot enter into consideration as a ground of legal objection. On the whole, therefore, we think the verdict is to be entered for the plaintiff, on all the issues except the fifth; that the verdict is to be entered for the defendants on the fifth issue—but that, notwithstanding such verdict, the judgment must be given for the plaintiff.

Mr. M. Smith:—My Lord, there are certain certificates which were to be given, in case the judgment was for the plaintiff.

The Lord Chief Justice:—You must apply to me for those; that is not a matter for the Court—that is a matter for myself.

Cambrian.

Specifications of English Patents.

Specification of the Patent granted to Henry Browne, *of Codnor Park Iron Works, in the County of Derby, Iron Manufacturer, for Improvements in the Manufacture of Steel. Sealed April* 22, 1841.

To all to whom these presents shall come, &c., &c. My invention relates to a mode of manufacturing steel from iron, by obtaining the iron in a fine granulated state, and then treating it with cementation with carbon, as hereafter described; and in order that my invention may be fully understood, and readily carried into effect, I will proceed to describe the means pursued by me. In working according to my invention, the crude, or pig, or refined metal, is to be treated as if about to be made into bar or malleable iron, by the purifying and decarbonizing process of puddling—that is, by stirring the melted mass in the furnace with iron tools, and exposing it to the action of the heated air, as usually practiced, until the metal becomes in a dry granulated state, all of which is well understood by puddlers; and in place of carrying on the process further in the puddling furnace, the iron, in the granulated state, is to be removed from the furnace, and when cold, a large proportion may be passed through sieves, the meshes

of which are about twenty in an inch, and the remainder may be crushed or ground, until the grains will pass through the same sieve, or the various sized grains may be separated by various sieves, differing in the size of the mesh according to the will of the operator; but I consider that the smaller the grains, the more advantageously will the process of manufacturing steel therefrom be carried on; and it is the converting of granulated iron, such as above described, into steel, by cementation with carbon, that constitutes my invention.

The granulated iron is next submitted to cementation, which I perform in the following manner:—I use an ordinary cementing, or converting, furnace, the nature of which is well known, and the cementing chests, or what are usually called pots, are about ten feet long, three feet wide, and three feet deep; but the dimensions may be varied. I prepare a number of frames of iron or wood—I prefer wood, and that which is called pine—an inch or two less in length and breadth, so that they will pass easily into the pots; the frame, made of wood, about a quarter of an inch thick, and one inch deep, and divided by wood partitions, at distances of about every ten or twelve inches. The carbon I prefer to use is wood charcoal, crushed and passed through a sieve, the meshes of which may be about one quarter of an inch square, though other carbon may be used. I place a quantity of the charcoal, to the extent of about half an inch in thickness, over the bottom of the pot; and this I cover with paper, or other suitable substance, on which I place one of the wood frames, and fill the compartments thereof with granulated iron, before described. On the surface of the granulated iron I place another covering of paper, and apply more charcoal, and press it into all the spaces between the frames and the sides of the pot; and I cover the paper evenly to the extent of half an inch; I then apply another thickness of paper, then another frame, which I fill with granulated iron, as before, and cover it with paper; then charcoal, then paper, and then another frame; and so on until the pot is full, having charcoal on the top to the extent of three or four inches deep; I then cover the whole close down with loam sand, or "swarf," from a cutler's grinding-mill, or other suitable substance, to exclude the air, tempered and spread over the top of the pot to the thickness of five or six inches. I now heat the furnace to a high heat, as is well understood by steel manufacturers, and let the pot and its contents remain at that heat for a sufficient time, which I find to be from thirty to sixty hours. The time and heat may be varied, according to the state of carbonization required. The pot and its contents are to remain until cool, and, when opened, the steel will be formed into cakes of the size of the compartments in the frames, and may be removed; the charcoal and paper may be brushed off. The steel thus produced is then broken into pieces, and melted in the usual manner, in crucibles. The high or low state of carbonization may be judged of by the color, which will vary from blue to purple, straw color, and gray; that which is blue having less carbon, and is less firmly united together; and that which is grey, and more united, is charged in a higher degree with carbon. The quantity and hardness of the steel may be varied by a judicious

selection of the cemented steel, so as to adapt it to the purposes to which it has to be applied.

Rep. Pat. Inv.

Specification of the Patent granted to JOHN BETHELL, *of Saint John's Hill, Wandsworth, in the county of Surry, for Improvements in Treating and Preparing certain Oils and Fatty Matters. Sealed March* 28, 1840.

To all to whom these presents shall come, &c., &c. The object of my invention, so far as relates to improvements in treating and preparing oils, is to render certain oils, viz: whale, elephant whale, Newfoundland whale, seal, rapeseed, teel, olive, palm, cocoa-nut, or any of the other common oils, more useful, either for lubricating machinery, or for the purpose of illumination, and which I effect, first, by separating, clarifying, or precipitating, a portion of the gelatinous albuminous, or other matters contained therein; and, secondly, (when such are required for burning in lamps, or for illumination,) by adding thereto a portion of hydrocarbon, or essential oils, hereinafter named; and as regards the treating and preparing of certain fatty matters, the object of my invention is the manner in which I have hereinafter described, from butter of palm, cocoa-nut oil, or any other vegetable concrete oil, an oil which is more useful for mixing my purified oils, and which process also improves the fatty matter, or concrete oil, so operated upon, and which improvements I propose to carry into effect, in manner hereinafter described; that is to say—as to that part of the invention which relates to oils:—

First Process.—I take any or either of the common oils above named, and I purify them from the gelatinous albuminous and other matters contained therein, by first thoroughly well mixing the oil with a solution of tannin, which may be obtained from any of the vegetable matters yielding it; but I prefer using a strong infusion of gall-nuts in hot water, of which I take ten gallons, and thoroughly mix it with 100 gallons of oil, in any convenient manner. This mixture must afterwards be allowed to rest for three or four days, until all the tannin infusion, and precipitated matter, has settled down to the bottom. The clear supernatant oil is then drawn off, and again agitated and mixed with a solution of either acetate of lead, acetate of alumine, or sulphate of zinc, which I prefer using in the following proportions—viz: 1 lb. of acetate of lead dissolved in 6 gallons of water, or 1 lb. of acetate of alumine dissolved in 4 gallons of water, or 1 lb. of sulphate of zinc dissolved in 6 gallons of water; and I mix 10 gallons of either of such solutions with 100 gallons of oil; but I do not confine myself to these proportions, as solutions of different strengths can be advantageously used for different oils. The oil, after three or four days' rest, is drawn off from the top, and, if not sufficiently clear, must be filtered through oil-bags, in the usual manner. During the period that the oil is undergoing the above operations, I prefer that it be kept at a temperature as near 17 ° Fahrenheit as pos-

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Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cost of Transportation on Railroads. *By* C. Ellet, Jr., *C. E.*

I have never yet seen any formula, derived from the experience of active lines, by which the cost of transportation on railroads may be determined with an approach to accuracy. The expenses of maintaining a line of railroad are not *all* proportional to the distance traveled by the locomotive engine, nor to the tonnage conveyed; neither are they all independent of either of these considerations. But the aggregate annual cost is made up of certain items, which are, in fact, nearly proportional to the distance run by all the engines; of others which are strictly proportional to the tonnage conveyed; and of some which are nearly, or quite, independent, both of the trade and of the distance traveled.

I offer the following rule for the determination of this aggregate, in the belief that every well managed railroad, of ordinary construction, carrying engines of ordinary power, where the transportation is effected at the usual speed, and which accommodates a respectable amount of business, will exhibit results in close agreement with its indications. This formula is derived from the considerations which follow, and the constant quantities are supplied from the best experience I have been able to obtain from the past management of the public works of this country. In course of time, when the velocity of burthen trains is reduced to three or four miles per hour, and companies learn to know where and how to economize, it is probable

that some of the items may be reduced; but time and experience have yet to decide how much.

I. *Repairs of Road.*—The repairs of a railroad consist of two distinct divisions; the first of which is nearly independent of the amount of the trade, and may be estimated, on the average, at about $500 per mile. The second division is dependent on the amount of the tonnage, and represents the injury done to the road by the passage of one ton of freight. I estimate this wear and tear at $\frac{35}{100}$ of a cent per ton per mile.

II. *Expense of Cars.*—The expense of repairing and renewing the burthen cars is proportional to the distance which they run, or to the tonnage of the line; and may be estimated at $\frac{45}{100}$ of a cent per ton per mile.

III. *The expense of agents, conductors, the force at depots, breakmen, and contingencies of all sorts,* is likewise nearly proportional to the business of the road, and cannot be assumed at less than *six mills* per ton per mile.

IV. *Locomotive Power.*—The expense of repairs and renewals of locomotive engines and tenders, the cost of fuel, and the pay of enginemen and firemen, are nearly proportional to the distance run, and may be estimated at *thirty cents* per mile traveled by the engine.

Now, to express the cost of maintaining a line of road, under good management, for one year, let us represent by

N the number of miles run by all the engines;
T the whole number of tons net conveyed one mile; and
h the length of the road in miles.

Then, according to the foregoing data,

$$\frac{3\,N}{10} + \frac{14}{1000}\,T + 500\,h.$$

will be the aggregate annual cost in dollars, (where the business consists exclusively of tonnage,) of maintaining the line and its equipage.

If the road accommodates a mixed business, of trade and passengers, to obtain the aggregate expense, we must add $\frac{1}{100}$ P—where P represents the whole number of passengers carried one mile.

This formula takes proper account of the difference of grades, but is not applicable to very short roads—to roads doing a very inadequate business—by which I mean less business than can be accommodated by one engine—nor to the first four years' operations, while the road, cars, and locomotives, are yet all new.

By applying this rule to the active lines of the country, it will be found that the larger establishments—those which possess a valuable trade—give very similar results.

There are none on which the expenses fall within the limit assign-

ed by the formula, excepting, perhaps, one or two which have been recently completed, and on which the cost of renewing the iron, timber, bridges, cars, and locomotives, is not yet very sensibly felt. It will be found to suit those cases better a few years hence.

[To be continued.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reply to the Notice of the "Projected Water Works at Albany, New York," published in the Journal of the Franklin Institute, vol. iii, 3rd series, page 380.

The following remarks are submitted in reply to strictures upon my Report on the Albany Aqueducts. Without intending anything disrespectful to the courteously expressed opinions of the writer, I may be allowed to say I am rather pleased the plan should have met with opposition—as this, I believe, has invariably been the fate of every new plan, of much importance, which has at any time been brought forward. I have only to regret that such extracts did not accompany the review as would have placed at least the main features of the plan before the reader in a perfectly *intelligible* shape; had this been done, present remarks would have been less necessary, as I trust to show, in a brief space, that the opinions advanced are *imaginary*, and rather the result of *misconstruction* of the nature of the *plans proposed*, or of *misconception* of *what really are the results of practice* on the part of the writer, and the practical friends consulted, than of any over-adherence on my part to "the theory of the question."

I. He cites a trial at Fairmount as a "stubborn fact," proving incontestibly that, *in practice*, water cannot be made to rise, in a jet, over three-eighths of the height of the fountain, or reservoir, and of course that the plan I proposed of making the head of water available for the extinguishment of fires, and which anticipated a jet rising much nearer the level of the reservoirs, must be wholly inefficient.

Now the *essential circumstance* of the trial having been made with a single adjutage of one inch diameter, has been entirely overlooked; while it is a "stubborn fact" that with a plentiful supply of water, and given height of fountain, *the height of the jet may be increased* through a very great range, simply by varying the size of the orifice of the adjutage. My plan had due reference to this appropriate orifice for the jet, and the writer's opposition to it arises from want of knowledge of any such requirement; in other words, from mistaking an *individual fact* for a *principle*, and resting his opinion entirely upon the *imaginary* strength of a trial, which could decide *nothing* except the naked fact that, with exactly the same plan and

arrangements, a jet of but thirty feet only can be produced. There can be no hazard in expressing the opinion that the head of water at Fairmount is capable of forcing up a jet of at least double this elevation.

Not to expatiate further on this, I will but mention some recent trials, which confirm, decisively, all the views put forth in my Report to the Common Council of this city. It is but a few days since jets of one hundred and fifteen feet were produced at the Haarlæm River, on the Croton Aqueduct; which proves that after allowing for the difference in the elevation of the fountains, all my anticipations will be *at least fully realized.* For the matter of that, the elevation of our fountain being two hundred and sixty feet above tide level in the Hudson, (nearly twice that at Haarlæm, and more than three times that at Fairmount,) I had all along anticipated much greater things than has recently been done at Haarlæm, in the lower part of the city, which contains the bulk of population, where I had no doubt we should be able to cast a jet over the spires of the churches.

II. The writer does not comprehend my plan. Every part of the conduit, except the brief length of the depurating sections, is graded, and descends from the reservoirs, and lies within fifty-five feet of the level of the fountains. Ventilators cannot, in any event, be requisite at more than two points, and can be effected at so small an expense, as not to be worth mentioning—any expense of this description being fully covered by, and provided for, in the allowance for contingencies in the estimates of cost.

III. The writer has again misconceived my plan. The *depurating sections* were subordinate appendages, established only where my plan of *grading the profile* required the level of the conduit to be *sunk;* and the only addition of expense on these sections was for "*roil-chambers,*" which were intended "to obviate all risk *from* deposition of sediment in the duct, and of interruption to the regularity of the supplies, &c.; to give absolute control over whatever of sediment the water might contain after being introduced within the conduit, and to provide for its removal from the conduit before reaching the city, at given periods," &c. Does the writer in the Franklin Journal hazard the opinion that in case of such deposites (which he admits do take place in the Philadelphia conduits, and of which I gave an instance in my Report, on a small, but still practical, scale,) the simple force of a current of one mile and a quarter per hour in the conduit, would be sufficient to *force* the sediment up the banks of a gulf rising eighty feet, at an angle slightly less than forty-five degrees; or that simple cocks, without any enlargement of the section of the conduit, would not require *frequent attendance at each, and*

be both troublesome and expensive to manœuvre; or that an enlargement must of necessity *sensibly* check the flow of the water? The roil-chambers do not demand constant attendance, and their cost could *not exceed the expense of cocks,* properly guarded from freezing up, as they must be to be of any practical value.

The mode of venting this, besides, gives at all times perfect command over the whole of the water in the conduit, and there are various ways in which this quality alone may promote the efficiency of the aqueduct.

IV. With regard to the thickness of the conduit, I have to remind the writer that he does not show that the *practice* in Philadelphia is founded upon any exact knowledge of their capacity to sustain a determinate pressure, or head, of fluid, with a given size of pipe. He is, doubtless, aware that the authority of *practice* is little more than the authority of *conjecture, where not so founded.* He admits, besides, that the pipes are actually tested at a pressure more than five times greater than the head they actually had to work under; that "they rarely fail, and that it may be said with truth, these failures usually occur at imperfections."

This is candid. Will the writer be good enough to define what degree of excess of thickness will always make pipes secure, on the supposition that they fail only at imperfections? If a part of the Water Works at Philadelphia had been laid with pipes of two-thirds of an inch thick, a part with pipes of half an inch, another with pipes of one-third of an inch, &c., something determinate, it is conceded, might have been concluded from the practice there. Had this been done, it would have been found that the least thickness would have stood equally well with the greatest; and that failures only occurred where imperfections existed at the time of laying them down; and *the practice would now be* to lay only the thin pipes—that is, it would have been so had further provision been made against corrosion of the pipes by rust, agreeably to the plans proposed in my Report.

I am not positive, but believe that the pipes of the conduit at Haarlæm, now on the Croton Aqueduct, are the three feet pipes which are ultimately to surmount the high aqueduct bridge over that river. They are now *actually working* under a head a great many times greater than can ever come upon them when occupying the position they are intended for. The actual head has been stated at one hundred and forty feet; consequently, if not mistaken in the size of the pipes, they are now actually working with *considerably less* than the equivalent of a quarter of an inch for a seventeen inch conduit, under a head of fifty-five feet. This is decisive as to the thickness *actually* required in practice.

The enormous surplus put into the Philadelphia pipes, merely to guard against an occasional imperfection, (which experience proves it fails to do,) seems to be but little more consistent than to add to that still more in order to render it impossible, in case of invasion of the good city of Philadelphia, for the enemy to uncover and fracture the conduit, by sledging.

The candor of the writer will now concede, I think, that the practice at Philadelphia does in nowise negative the dimensions assigned in my Report on the Albany aqueducts, and that other works, on a still grander scale, *fully confirm* their efficacy at least; and, consequently, that *actual practical cases* afford sufficient evidence that my estimates of the cost of erecting the conduit, are at all events *not too low.*

V. With regard to the length of the links of conduit, I have nothing to reply, but to state that when skilful founders shall, under the inspection of the writer and myself, make an attempt, with additional sprues, &c., another expedient a little out of the usual routine, (as was suggested by Mr. J. Rogers, one of our most skilful machinists, and himself an experienced founder, as the means of meeting the difficulty of casting thin pipes,) and shall fail in ability to produce links of fifteen feet, I will cheerfully surrender my conviction, on this head, to the writer, and use lengths of ten feet.

VI. It is certainly true, in theory, that the protecting metal in a galvanic circuit is in itself liable to corrosion; but is not the writer in the Franklin Journal aware that this is not always necessarily so *in practice?* and, with regard to zinc, particularly, we have the authority of Sir Humphrey Davy (who determined the question in the most explicit manner, with express reference to an equally important and practical subject,) that after the first coating of oxide has formed, that that coating effectually protects the zinc from further detriment, while the iron remains perfectly under the influence of the galvanic action excited.

But the writer has, besides, misapprehended my object entirely. I did not propose zinc as a better material than lead for simply *closing and securing the joints*—nor yet because it was cheaper. Perhaps no metal whatever can afford a more perfect joint than lead, as regards both "tightness and durability." My object was much more important than either of these. I proposed to employ it *solely on account of its protecting quality,* with the view of dispensing with the enormous quantity of material usually put in the body of pipes, considering that if the oxidation of the metal were arrested, surplus beyond a certain thickness could serve no useful purpose.

The writer is too liberal, I think, to object because I kill, as it were,

two birds with one stone—the plan proposing to arrest the corrosion by the same operation which closed and secured the joints.

As regards the great expense of sealing with zinc, the writer forgets that a given volume of zinc does not weigh more than two-thirds as much as the same volume of lead, and, consequently, that ninety-four and a quarter pounds of lead are required for sealing the same joint that sixty pounds of zinc would secure. The prices of the two metals being nearly inversely as the weights of metal required, leaves the expense of sealing a joint about the same, which ever metal is used. But even if this were not so, the object with which the metal is employed is a paramount consideration.

VII. As regards the velocity of the pistons of the elevating machinery, I beg leave, with due deference, to say, I cannot perceive any force in the writer's theory as to "the momentum not being kept up whilst the piston clears the dead points, &c." The writer, in the fervor of his affection for the Philadelphia works, seems to think these works a model of perfection, which can in no respect be departed from without "practical error." Beautiful and useful as are the celebrated works of Fairmount, I must be permitted to say that the writer entertains very erroneous and unsubstantial views when regarding them as paragons of perfect skill. That the whole works of that city might have been made vastly more useful and efficient, at an expense very much less than they have cost for construction, I cannot but think must be apparent to every person capable of understanding and appreciating the discussion which the writer's critique has produced.

That there are other *very* important points of difference between the projected Albany works and those at Fairmount, is a truth of which I was aware at the time of proposing my plans last autumn; but these, like the rest, were designedly so, though in nothing which is not justified by the errors of practice.

Wm. McClelland Cushman, C. E.

Albany, New York, July 22nd, 1842.

Facts and Observations on Four and Six Wheel Engines.
By John Herapath, Esq.

[continued from page 79.]

North Midland Railway.

We believe that this line was originally projected by Mr. Henry Patteson, the late Secretary, and Mr. George Stephenson, the Engineer. It unites Derby with Leeds, and forms part of the main trunk line to the north of England, on the east side of the island. Its length is 72¾ miles, and it joins on the south at Derby and Midland coun-

ties, and the Birmingham and Derby Junction Railways; and on the north, the Manchester and Leeds, Leeds and Selby, and York and North Midland.

One of the most troublesome works upon this railway was the Clay Cross Tunnel. In fact, it was almost another Kilsby affair; and even now is a constant source of annoyance from its gradient and the wet, which oblige the engines passing one way through, that is from Leeds towards Derby, to be always using the sand-hoppers to give bite to the wheels.

On this line I observed a peculiarity in the mile posts which I do not remember to have seen on any other line, and with which I was much pleased—that is, the mile posts have large round heads, by which they are immediately known, even in the night; and the ¼, ½, and ¾ mile, were simply straight posts. The mile posts have marked upon them the gradient of the place, with a line between the figures, inclined to the horizon in such a way as to show which direction the ascent or descent takes. Simple as this contrivance appears to be, it is very useful to travelers, and it might be advantageously introduced upon all railways. We believe it was designed by Mr. Robert Stephenson, the engineer of the line.

A remarkable feature on this line is the stations; perhaps the neatest that I have seen upon any other line of railway. The average cost of them, I understand, is about £3,000 each. But of all railway stations, that at Derby claims most the traveler's attention. It was stated to me that it stands upon about 33 acres of ground, and cost nearly a quarter of a million of money. The extreme length of the shed is 1,050 feet; and breadth, 140 feet. It appeared, I thought, to be inconveniently long; but I was informed that it was often filled from end to end with carriages. The business of all the three Companies is here carried on by the North Midland Company. I had no opportunity of going much over the offices, but from what I saw of them, I thought them pretty well laid out. Their only fault appeared to be that they were rather too capacious, which is, perhaps, erring on the right side. I went over the store department, under the management of Mr. Finlayson, and was exceedingly pleased with the order, regularity, and systematic manner in which the stores were kept. Every item had its separate and appropriate place; and there was not a nook in his offices which was not advantageously occupied.

Their workshops are upon the plan of the Wolverton establishment, as might have been expected from Mr. Glyn having presided over both Companies; but they have not yet arrived at that maturity in their machinery, &c., which the London and Birmingham Company have.

Here I had an opportunity, through the politeness of Mr. Finlayson, of seeing Mr. Edmonson's plan for printing and numbering railway tickets. Some idea may be formed of the utility of this invention, from the fact that it printed and numbered consecutively from 4 to 49 in one quarter of a minute, or above three in one second—the man not working the machine over fast. It is, certainly, a very simple and useful invention.

The Midland counties locomotive establishment here is not on so extensive a scale, but, from the cursory view that I took of it, it appeared to be more matured. I had no opportunity of going over the Derby Junction locomotive establishment, as I was suddenly called to town.

Monday, Nov. 6, I came in upon this railway at Leeds, on my return from the north.

Their engines are all distinguished by numbers, as on the London and Birmingham Railway. I got upon No. 7 engine—6 feet driving wheels, eighteen inch stroke, 14 inch clylinder. She certainly was not one of the most steady engines that I have been upon, nor one that I should at all call steady. The next day I took a trip with Mr. Marshall, the superintendent of the North Midland locomotives, from Derby to Masborough, and returned on No. 19, an engine by Robert Stephenson. This was a much superior engine to the last, in point of steadiness and ease of motion. She had none of that pitching and working against herself, nor any of that wriggling motion of the former. I understand that she was one of Stephenson's latest engines.

As the engines on this line are all six wheeled, and of nearly the same pattern, I did not think it necessary, particularly as my attendance in town was required, to go upon more than the two I had tried.

Their stock of engines consists of 30 passenger engines, uncoupled; and 10 good engines, coupled. They are all six wheel engines, with outside bearings. Seventeen engines have six feet driving wheels, and four feet leading and trailing wheels, with 14 inch cylinders and 18 inch stroke. Their weight is 18 tons in a working trim—that is, 8 tons on the driving wheels, 6 on the leading, and 4 on the trailing wheels. Three engines are exactly similar to the above, except having wheels 6 inches smaller in diameter. Ten engines have 5 feet driving and leading wheels coupled together, with 3½ feet trailing wheels. In other respects they are similar to the former. Ten engines have 5½ feet driving wheels, and 3½ feet leading and trailing, with 13 inch cylinders, and 18 inch stroke. The weight is 15 tons, distributed in proportion to those of the 17 engines above mentioned.

Of these 40 engines, 30 are in a fit state to take a train. The driving wheels have no flanches, and the coupled engines are said to work very satisfactorily.

The gross average load of the passenger trains, including engine, tender, and empty carriages, is 60 tons; and 150 tons the goods trains.

There have been about 30 detentions of trains from partial derangement of the engines, one third of the causes of which occurred in the boiler and wheels, another third in the cylinders, and the last third in the valves and pipes. In one year and a half there have been three broken crank axles while running, and three others were replaced before they were broken through. Those running were unable to proceed with their trains, but stopped in a short distance, without getting off the rails, or any accident to the passengers. Mr. Marshall said the axles broke from the imperfect welding of the iron, or flaw in the crank. These accidents all happened with uncoupled engines,

two on a straight line, and one on a curve. There have been no engines run off the line. The axles which broke were 5½ inches diameter; the driving wheels 6 feet, 14 inch cylinder, and 18 inch stroke, with a steam pressure of 60 lbs. in the boiler, which appears to be the average pressure of their engines.

The average cost of the engines is £1,600; the consumption of coke, 33 lbs. per mile for the passenger engines, and 50 for the goods engines, or 40 for the average, and 46 per mile consumption of the regular trains, including pilot and assistant engines. The general character of the engines is stated to be steady in their motions. They are 18 feet long, and 11½ feet distance between the extreme axles. They have no proof that the distance of the cranks from the middle of the axles produces any sinuous motion.

The total number of miles run per annum is 600,000, or 15,000 per engine per annum, at an expense of 3¼d. per mile each engine. I suspect this is for the repairs only. The age of their engines is all one year and a half.

Each engine takes two trips per day, of 73 miles, or 146 miles daily; and their average time of work is three days out of four.

Great North of England Railway.

All the passenger engines of this Company, except two built by Robert Stephenson, are made to a pattern engine furnished by Hawthorn & Co. They have 12 inch cylinder, 18 inch stroke, and 5½ feet driving wheels. The distance between the leading and trailing wheels is 10½ feet; between the centres of the cylinders, 1 foot 11 inches, which accounts for the rather unusual height of the boiler, which I noticed above the framing. They run from one end of the line to the other, and back, daily—90 miles—and stay in one day out of four, for repairs, &c.

The merchandize engines are also built to a pattern furnished by Hawthorn & Co. The front and driving wheels are 4½ feet diameter, and coupled. They are principally used in taking coals to the depôts along the line, and consequently have no regular daily distance to run, but remain one day in five in the shed, to clean and repair. They draw from 26 to 36 coal wagons, each weighing, when loaded, 5¼ tons; and, of course, have the wagons to bring back empty.

Their stock of locomotives consists of 12 passenger, and 20 merchandize engines—including two ballast engines, used in forming the line, which are at present out of repair. They are all six wheel engines, and all have outside bearings, except two passenger engines, which have additional inside bearings on the crank axle. Their engines have not been weighed. The gross average load of the passenger trains is 50 tons, and of the merchandize 130. Twenty of these engines have four wheels, coupled, which are found to work steadily and safely; but they are only used at slow speeds. All the engines but three have flanches on the driving wheels. With the exception of four, and the two ballast engines mentioned above, they are all in a fit state to take a load. Twice only have the trains been detained from the failure of machinery—in one case from a broken piston, in

the other from a burst tube. They have had no broken crank axles, nor any instance of engines having run off the rails, except from neglect of points or switches, or through collisions. The average cost of their engines is from £1,500 to £1,700 including tender. Average consumption of coke from 36 to 38 lbs. per mile. The engines are described to have scarcely any motions, except what may be attributed to imperfections of the road; nor have they any top-heavy engines. The total daily run of the passenger engines is 450 miles, and of the merchandize, 320—exclusive of ballast engines. The steam pressure is from 50 to 55 lbs. per square inch. At present the expense of repairs cannot be ascertained, on account of the line having been opened so recently.

London and South Western Railway.

The delay in giving my account of this railway has arisen from having learned that they have four as well as six wheel engines, which I was very desirous to try together on the same line. This line, which was originally laid out under the name of the London and Southampton Railway, was evidently designed to become the grand trunk line to the west of England, and altogether to supersede the necessity of the Great Western Railway. From the detour which it makes just below Basingstoke, it was obviously meant to be extended westward, so as to take in Salisbury, and all the western parts of England, and to make the line to Bristol a branch of it. The imbecility, however, of its former management, and the extravagant expenditure of the Great Western, defeated their object, and confined them literally to the title of their line, a London and Southampton railway.

On Nov. 13th I had an opportunity of riding on three of the Company's engines. I went down to Winchester on the *Queen* engine, a six wheel, with 5½ feet driving wheels, 18 inch stroke, and 13 inch cylinder. Her weight was stated to be 14 tons 14 cwt., and the tender half the weight. Its total length was 15 feet, and the length from the hind axle to the driving axle was 5 feet 2½ inches. The hind axle to the front was 10½ feet. The coupling with the tender was rather below the driving axle. She had outside bearings, and flanches below the driving wheels. Her working time is said to be about 9 months out of 12. She consumes 17 cwt. of coke every journey of 76½ miles, and the driver said about 1,400 gallons of water. The play of her wheels upon the rails was one inch. She is considered to be a very good and steady engine. All the through engines run a journey each way daily, generally without drawing the fire. In one case I was told this engine ran about 306 miles without having the fire taken out. Each engine takes the mail train a week round. The driver of this engine, who appeared to be a steady and attentive man, and had been upon the London and Birmingham line, considers outside bearings to be more unsteady than inside. He thinks on bad roads six wheel engines are steadier than four, but admits that the London and Birmingham four wheel engines work very well. This engine appeared to me to have a sinuous motion of about two inches,

and no pitching or rolling motion. Her front springs were in a constant play, and she was easy to ride on. On curves, and drawing up hill, she appeared to be rather steadier; but in descents, at high velocities, her sinuous motion was very marked.

At Winchester I dismounted, and waited until another engine, the *Eclipse*, came up, on which I went to Southampton. This was a six wheel engine, with outside bearings, and a 13 inch cylinder; but I could not get the length of the stroke. From the hind to the driving axle she was 5 feet 1 inch, and to the front axle 10½ feet—the same as the *Queen*. Her total length was 15½ feet; she had a play of 1.2 inch on the rails. The whole of the way I rode with this engine was down hill, and at a high velocity. After making her what I thought a fair allowance for these circumstances, she appeared to me to be more unsteady than the *Queen*, and had much more sinuous motion. Her apparent sinuous motion was full three or four inches. The coupling appeared to be one foot above the driving axle, and she was pulling upwards. Probably the play of the axles on the bearings was partly the cause of her greater unsteadiness.

I left Southampton at six, by the *Orion*. It being dark, I could get no measures. She had outside bearings, and was apparently a much better engine than either of the other two, as to sinuous motion, but very disagreeable to ride upon. I rode upon her from Southampton to Basingstoke, and, therefore, had a fair opportunity of trying her both up and down hill. It appeared to me as though she had no springs behind, she was so exceedingly rough.

I traveled 106 miles on these three engines. It being dark when I was on the *Orion*, I had an opportunity of judging how far lights in front might be of any service, so as to prevent accidents. My opinion certainly is that no light, however strong, placed in front of an engine, will ever answer any useful purpose of apprizing the driver of an object before him in time to stop the train, if he is going at anything like a railway velocity. To be efficient under all circumstances, a light must be intense enough to illumine an object a mile off, in such a way that it shall be rendered visible to the man on the engine. Now, setting aside the difficulties of curves, &c., can any one imagine such a thing possible?

It has usually been said that an engine ought not to travel beyond 30 miles at a time, but this Company's engines travel two and a half times that distance, without any apparent inconvenince.

The South Western stock of engines is 48, four only of which have four wheels, all the rest being six wheel engines. The four wheel engines have inside bearings; the others have both inside and outside bearings on the crank axles. Of these engines, 42 in the middle of November were ready to take a train. The six wheel engines are said to cost £1,300; the four wheel, £1,000 each. The average gross load is 74 tons; the consumption of coke 34 lbs. per mile. They describe their six wheel engines as much steadier than their four, and prefer them on account of this quality and their greater safety; but they admit that any unsteady motions of the engines arise generally ·mperfections of the road, as the primary cause. Their pressure

in the boiler is 50 lbs. per inch. The total locomotive expense per mile, 18d., and the total miles run in one year, 600,000.

They have had no engines run off the line, and have made no returns as to how many broken axles, or detentions, they have had, from partial derangement of the engines. We believe the cause for this is the destruction of their records at the late fire. At present, we understand that no Company's engines work with more regularity, or fewer accidents. Railway Mag.

[TO BE CONTINUED.]

Mr. Vignoles' Lectures on Civil Engineering, at the London University College.

[CONTINUED FROM PAGE 85.]

On Earthwork.

Lecture V.—Wednesday, December 22nd, 1841.—The Professor commenced by stating that earthwork, taken in the present extended sense of the word, was but little known to the ancients. The gigantic operations in earthwork of modern times correspond with the viaducts of the ancients. Our earthwork may be confined to excavation, cutting, and embankment, or getting and filling, as ordinarily denominated by contractors. He then went through the whole process, giving the scientific and common names of each description of work. With respect to the works of the ancients, in the canal made by Cyrus, the Phœnicians were the only workmen who cut the canal with slopes; all the rest employed cut straight down, and, in consequence, the former stood, while the latter fell in. The River Po, in Italy, was a curious instance of embankment; this river is situated in a very flat country, and makes an annual deposit of a calcareous matter, which, hardening, raises the bed of the river in a slight degree every year. The ancient inhabitants, to prevent their country from being inundated, were obliged to raise a small embankment on each side of the river—perhaps two or three feet high—which, having served for some years the desired purpose, and the bed of the river having become higher from the deposit, the embankments required to have still more added to them, until, after the lapse of centuries, the bed of the river, from the constant deposit of calcareous matter, and the consequent necessary additions to the embankments, to the height of thirty feet, is now several feet above the level of the surrounding country. This work looks like one of our modern gigantic works, but it bears no comparison to the labors of the present day, it being but a work performed from year to year, in small portions at a time, while ours have been formed at one operation. From all his researches, he, therefore, came to this conclusion, that, until late years, earthwork was but little known; he could make the same remark with respect to cutting. This work was first treated systematically by military engineers, in fortifications on the continent, after the invention of cannon. Authors of that period lay down many curious rules for forming ramparts. Various useful calculations are given, to determine the best mode of making the matter taken from the ditch

exactly sufficient to form the rampart, in order that there should be none either to procure or to carry away. The next is in the construction of canals; the same rules were followed as in the construction of ramparts. In road-making the same calculations were made; the whole aim of the engineer being to make the imaginary line, called the "balancing line," so perfect, that the earth removed from the eminences should fill up the hollows in the irregularities of the country through which the road was to be made. The cause of these fine calculations was the difficulty and expense of carrying away the superfluous earth to another place. The absence of great undertakings on the continent is attributable to the want of our modern appliances to get rid of the superabundant matter. In the contracts sent in by foreigners for works abroad, it is amusing to see the finical exactness with which the contractors calculate the expense of removing the first 100 yards, then the next 25 yards, and so on increasing, until they get to 300 yards, beyond which the price is enormous. It is only within the last three years that they seemed to have the slightest idea of the plans in use in England for facilitating this work; it is certainly not more than thirty years ago that we commenced using the tramroad. First of all, the only plan was to remove the earth in barrows; then the clumsy three-wheel cart was introduced; after that tramroads, and now edge-rails, with the application of a locomotive—so that thirty years have changed the load from 2¼ cubic yards to nearly 100.

Before railroads came into general use, deep cuttings were executed, and one remarkable instance Telford has left behind him in the Birmingham Canal, which is remarkable for boldness of idea and success of execution. Near Market Drayton there is an embankment, began fifteen or sixteen years ago, and which is as yet hardly finished, so great has been the slipping, and so difficult the remedy. This work is a remarkable instance of the combined bad effects of a bad mixture; the slopes have flatted down until nearly in the proportion of 14 to 1, and it is now more like a large hill than an embankment. There is an instance of a deep cutting, by Dodd, at the Highgate archway; it was intended, first of all, to make a tunnel, but, from the constant slipping of the earth, it was obliged to be made into an open cutting. The present bold mode of cutting down large hills, and filling up deep vallies, in the formation of railways, is due to George Stephenson, and in the construction of large cuttings and embankments for canals, to Telford, whilst Dodd made the largest cuttings for roads. On the Holyhead road the failure of the embankments and cuttings in the London clay, will teach a good lesson to the young students. The point to be considered is, which, of masonry, aqueducts, tunneling, embankments, or cuttings, would be the cheapest mode of doing the work proposed. At the present time, earthwork is the cheapest, for modern practice has reduced it to a price per cubic yard. In the contracts for the Paris and Rouen Railway, the contracts sent in by the French engineers were invariably three or four times the amount of those sent in by English contractors. Thus, notwithstanding the expense of transporting the work-

men into France, the whole of that work is in the hands of Englishmen.

The engineer, to form a just calculation, must well study the character and mechanical properties of the soil, and the necessary slopes. Experience alone can teach these points. There are many varieties of the London clay, which, when cut down to a certain depth, on exposure to the atmosphere, are sure to slip; another cause is, the great haste with which the embankments, &c., are formed. When the water does not penetrate, this clay is very hard; but after exposure, it melts away like tallow, and the only remedy is to get rid of the water by draining. When a slip takes place, the toe of the embankment bulges forward. In the first instance, the surface should be well drained a short distance from the edge—the drain to be puddled, in order that the water should not penetrate; borings should be made horizontally, and the water tapped; when expense and time are no objects, the whole should be cut in steps, and drained by means of wattles, so that if a slip takes place, it is only partial. The force with which the toe of the embankment bulges out is such, that a wall of masonry would be of no use, as it would be pushed out; the most effectual preventive, or remedy, is wattling and bush drains. When time will allow, it is better to make the embankments in layers, and between each layer of earth putting in a course of brushwood, clippings of hedges, or wattlings. When embankments are obliged to be poured out hastily, allow them to take their natural slope, and if it slips, let it remain; for however much it may be attempted to reduce it to its former shape, it will still again slip and regain its position. A good practice to provide against slips is, to form a slight abutment of earth a short distance from the toe of the slope, so that it should stay the slip if it takes place; this plan is more particularly available when the work is obliged to be erected on a natural slope —for instance, on the side of a hill. The Professor then, for the information of the younger students, explained, by diagrams, the nature of slopes, and the meaning of the expression "two feet to one," &c., and concluded by recommending that, in forming slopes, the engineer should run some risk of slips, in order to save the great expense of removing more earth than is actually necessary—the cost of repairing these slips being but little in comparison. He likened the work to an insurance on life, the risk to be run being calculated upon by precedents. The principle is to get the greatest extent of work finished at the least possible expense, and many of the great slips that have taken place might have been prevented, or speedily cured, had the plans he laid down been better followed.

Lecture VI.—Wednesday, December 29th, 1841.—Professor Vignoles stated that before continuing the subject of earthworks, he wished to set right an erroneous impression with the public, in consequence of an expression he made use of at his last lecture; he had then recommended that "the engineer should run some risk of slips, in order to save the great expense of removing more earth than was actually necessary—the cost of repairing these slips being but trifling in comparison." He need not say that he so expressed himself, but

it was always on the supposition that no risk was to be run where there was the remotest probability of danger. He mentioned this because of the circumstance of the slip on the Great Western Railway, which was attended with such fatal results, and happening only a few hours after he had made that statement. From all that had been stated, it appeared that the slip itself was but very inconsiderable; the cutting where it took place was 57 feet deep, the slope two to one, and the width of the road 40 feet; the slip took place about half way up the bank. A number of smaller slips had occurred, and tiles were used for draining, instead of bushes, &c., to cure them—still the mode of curing them was the same as he advocated—by drainage. As he had before stated, the slip itself was very inconsiderable, but, by having nothing to check it, the earth fell upon the rails. A doubt seemed to exist whether the concussion produced in the air by the passing of the former train, had not brought it down, for the accident happened in the interval between the passing of the two trains—the first one having proceeded uninjured, whilst the latter was attended with such fatal consequences. If the precaution had been taken, when it was first observed that a slip was likely to occur, to put up a fence of hurdles to check its advance to the rails, doubtless, the accident would not have happened. The manner of the slip showed that it was caused solely by the infiltration of water, probably a considerable way back from the edge of the cutting, or, perhaps the water had found its way in by the ditch along the top; the water which had thus got into the soil having expanded during the frost, the sudden change of the weather brought down the earth. The Professor then, by means of a diagram, explained the nature of the cutting, from which it appeared that the "top lift" was deposited in spoil bank. At the top of the cutting, a drain had also been cut, but he was of opinion that such drains were injurious, when the soil was at all precarious. The spoil bank was not the occasion of the slip, since it did not take place at the top, but bulged out in the middle. Although this slip was very small, from the fatal effects which attended it, it was the more necessary to guard against the recurrence of the like. There were but a few feet of earth on the rails, yet the effect was the same as if so many planks had been placed upon them. The Croydon slip arose from the same cause, but, though so much larger, no accident occurred. In the late accident there were but thirty or forty wagon loads of earth, and all was right again in a few hours, while in the Croydon slip 3,000 or 4,000 cubic yards of earth fell; the soil in both instances consisted of the London clay, with potholes of sand. It was clear that the accident was not to be set down as one of cutting, similar slips having taken place upon cuttings not more than twelve or fourteen feet deep. He must impress upon the minds of the students that it was not the length or depth of the cuttings which regulated the slopes, but the soil and practicability of drainage; unfortunately it was impossible to know exactly how these matters might stand—experience alone could teach them. He had dwelt long upon this subject, but he wished it to be understood that it was well-judged economy he advocated, not such as would, in the

least degree, tend to produce such fatal effects as in the case previously alluded to.

The balancing of the line was equally necessary for railroads as for canals or common roads; it should be the engineer's aim that the quantity of the earth from the cuttings should be as near as possible sufficient for the embankments; compared with former times, the mode of transit was so much facilitated, that where some years back it was necessary that the balance line should be limited to the hill to be cut through, and the valley to be filled up, now the line might extend two or three miles. It was essential in balancing that the engineer should be aware of the different degrees of compressibility of the matter; it was known of sand that it would occupy the same cubic contents in the embankment as it did in the hill, and one yard or 100 yards of gravel would be still the same; but in clays it was very different, they occupying less space in the embankment than they did in the hill, in their original position; 100 yards of clay would not make 100 yards of embankment, the average amount of compressibility being not less than ten per cent., or even, upon occasions, as much as 15 per cent. He had known occasions when 100 yards cut from a hill had only made 85 yards of embankment, but, upon an average, it would require 110 yards of clay to make 100 yards of embankment. Rock cuttings, on the contrary, expanded, because the solid rock could never again be restored to the same degree of density; the difference would vary much, according to the size of the fragments; but where the pieces were large, 100 yards would make 120 yards of embankment.* Chalk, again, would be rather upon the excess, though much depended upon its quality. In rock cuttings you might make them nearly perpendicular, but in chalk much discussion † has arisen as to what was the proper slope, some engineers having even recommended that it should overhang the road; but he contended that it should slope, to carry off the water. He had found a slope of one quarter to one generally sufficient. Rock chalk would stand perpendicular, while several of the softer descriptions would require a slope of one half to one, or even two to one.

The Professor then proceeded to speak of the correct mode of computing the quantity of earth in a cutting or embankment, and made a section of a hill half a mile long, to be cut down, the true cubic contents of a portion of which was 332,000 cubic yards, computed according to the prismoidal formula; but the ordinary method by which contractors would calculate the contents of the hill, by mean heights, would only show 310,000 cubic yards—that is to say, there would be a difference of 22,000 cubic yards against the contractor, the consequence of which had been, that the person contracting to cut down such a hill, at so much per yard, would lose, from his bad method of calculation, above £1,000. Another method was also in use—calculating by the mean area; which system, instead of 332,000 cubic yards, would show 376,000 cubic yards—being an excess in

* These remarks strongly corroborate those of an American engineer, inserted in th Journal of December last.—[Ed. C. E. & A. Jour.

† See the evidence on the Brighton Railway before the House of Lords.

favor of the contractor of 44,000 cubic yards. Many contractors had realized large fortunes by mean areas, and sustained serious losses by mean heights. Having thus shown the erroneous methods of calculation in use, he then, at some length, explained the prismoidal formula, accompanying his instructions with many diagrams, without which, any attempt at explanation on our part would be useless. The learned Professor concluded his lecture by strongly recommending a close study of mathematics to the junior (all) students, as the greatest assistant to the labours of the civil engineer.

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(To be continued.)

Wooden Pavements.

In some of the English periodicals, lately received at the Institute, we notice statements to the effect, that pavements of wood are generally approved in England, are rapidly extending in London, and that even the Thames Tunnel *is to be paved with wood.*

From all this, we are induced to believe that some superior mode of laying and preserving these pavements has been adopted in England, which is yet unknown amongst us.

For here in the United States, *wooden pavements are regarded now as a decided failure*, so much so, indeed, that considerable surfaces of them are now about to be removed, both in New York and in this city, and replaced, partly, by cubical blocks of granite, and partly, by the ancient water-worn pebble stones, so long used in the American cities.

We should, therefore, feel indebted to our scientific cotemporaries on the other side of the water, if any of them would furnish for our information, through the columns of their valuable periodicals, a statement

I. Of the original cost, in London, of the finished wooden pavement per square yard.

II. Of the durability and annual repairs of the same.

III. Of the most approved mode of cutting and preparing the wooden blocks, forming the foundations, and laying the pavement ready for travel.

The great objection here urged against wooden pavements, is their *very rapid decay*, and the unpleasant nature of the traveling over them, as soon as they begin *to rot in holes;* which we find to take place, with those which have been here laid with hemlock timber, in the very short space of *about four years.* M.

Bibliographical Notice.

"*A descriptive and historical account of Hydraulic, and other, Machines for raising water, ancient and modern: with observations on various subjects connected with the Mechanic Arts, including the progressive development of the Steam Engine. Description of every variety of Bellows, Piston, and Rotary Pumps, —Fire Engines—Water Rams—Pressure Engines—Air Machines—Eolipiles, &c. Remarks on Ancient Wells—Air Beds—Cog Wheels—Blow Pipes—Bellows of various people—Magic Goblets—Steam Idols, and other machinery of ancient Temples. To which are added experiments on blowing and spouting tubes, and other original devices. Nature's modes and machinery for raising water. Historical notices respecting Siphons, Fountains, Water Organs, Clepsydræ, Pipes, Valves, Cocks, &c. In five books, illustrated by nearly three hundred engravings. By Thomas Ewbank.* New York, D. Appleton & Co., 8vo., pp. 582."

We have given the entire title of the work we are about to notice, deeming this necessary in order to convey a proper idea of its contents. The general object of its author is to furnish the history of the origin and progress of the various machines which have been invented and used for the raising of water; and the five books into which the volume is divided, treat, 1st. On primitive and ancient devices for raising water. 2nd. On machines for raising water by the pressure of the atmosphere. 3rd. On machines for raising water by compressure, independent of atmospheric influence. 4th. On machines for raising water, (chiefly of modern origin,) including early applications of steam for that purpose. 5th. Novel devices for raising water, with an account of siphons, cocks, valves, clepsydræ, &c., &c. To these five books is added an appendix, containing miscellaneous items on various matters related to the general subject.

We have long known that Mr. Ewbank was preparing this work for the press, and have looked for its publication with a conviction that we should derive much valuable information from its perusal; an expectation that has been fully justified by the result. It is not our design to give a regular review of this work; indeed, this would be hardly possible, as it is itself a review of the origin and progress of hydraulic machinery, and does not pretend to give a minute description of the individual machines to which it refers. Those who are acquainted with that very interesting work, "Beckman's History of Inventions," will form a pretty correct idea of the nature of the present work, when we say that there is much similarity in the general character of the two; the main difference being that Beckman treats brief-

ly of the origin of inventions in general, relating to the useful arts, whilst Mr. Ewbank has limited his inquiries to a single, but comprehensive, class, with some of its genera, species, and varieties. The object of Beckman did not require the aid of the engraver, his subject being the origin of the arts, and not a description of any particular machines; whilst without the numerous illustrations given in the cuts in Mr. Ewbank's work, it would have been one of little value. There is in this respect, as well as in some others, a considerable resemblance between the book before us and Stewart's Anecdotes of the Steam Engine.

The reader of Mr. Ewbank's work will be disappointed should he expect to acquire from it a knowledge of the greater number of individual devices which have been introduced as improvements in hydraulic machinery; if he wishes to learn how the different kinds of pumps, or of valves, are constructed, he must, to acquire this knowledge, study other works; but if their history, from their rude beginnings to the state in which we now find them, is a matter of interest to him, he will find more in this work to gratify his curiosity respecting these, and numerous other inventions, than in any other which we could name.

We have said that Mr. Ewbank's book has been long in preparation for the press, and the evidence of this appears on almost every page; the authorities cited manifest unwearied, and very extended, research in books but little read, and difficult to obtain; and the manner in which the materials thus accumulated have been employed, reflects a very high degree of credit upon the author; whose life has not been that of a book-worm, but of a mechanic busily engaged in the working of metals; and who having by persevering industry acquired enough to render him independent of the melting-pot and the draw-bench, has been with equal diligence devoting himself to literature, in a department for which he had been fitted by his previous pursuits in business, and his habits of careful inquiry and observation. His work is not one which can fall still-born from the press, as it is not one of those ephemeral productions that must sell at the moment, or never; it is not an account of individual machines of recent invention, which are doomed to be superseded by the improvements of tomorrow; its historical details will be as useful, and the remarks upon them as interesting, half a century hence as they are at the present day.

From the nature of the work, it is miscellaneous in its character, and the materials which enter into its composition, might, undoubtedly, have been disposed in somewhat better order; but the former part, we are told, was stereotyped before the latter portions were written.

There are here, and there, some reflections and opinions relating to the political organization of society, which, however true in themselves, might have been advantageously omitted, as they are not only foreign to the subject of the work, but are, in some cases, calculated to offend; this we consider as a blemish, which is not fully redeemed by the many well conceived and happily expressed observations that render the book, as a whole, highly creditable to its author, who has himself anticipated the foregoing objection.

We have not made any extracts from the work, because it is our intention, at an early day, to republish some entire articles from it, which will exhibit its character more perfectly than could be done in the space allotted to this notice.

Notice of the United States Almanac, for 1843. *By* S. C. Walker.

We have been favored with the inspection of the printed sheets of a forthcoming work, by John Downes, entitled "The United States Almanac, for 1843."

Mr. Downes is favorably known to our readers, by his announcement of the lunar occultations of the fixed stars, which appeared in this Journal in 1841; these were interrupted by his engagements in the North Eastern Boundary Exploration, under Maj. Graham. As the Boundary question is now settled, we may indulge in a hope that these useful announcements will soon be resumed. The astronomical and engineering department of this work contains about one hundred pages of close print, embracing a complete calender, suited to any part of North America, from 10° to 50° North. The columns of the times of rising and setting of the sun and moon, and of high and low tides, are of sufficient compass for all this region. To the practical astronomer the work commends itself, by the general discussions of the Solar Eclipse of June 27th, 1843, which is visible in part of Louisiana, in Mexico, Texas, West Indies, and South America; also by the table of selected occultations, visible in North America, of stars, down to the seventh magnitude, inclusive. In preparing it, reference must have been made to the original star catalogues, as there is no general list of this kind published in Europe below the sixth magnitude. A list like this serves to form the basis for computing such special series for Philadelphia as have hitherto appeared, and will we hope again appear, in the Journal. The particulars respecting the planets and asteroids, are given with sufficient minuteness for the amateur, though not, perhaps, for the practical astronomer. Quite different is the case with the Ephemeris of the sun and stars, which are taken from the Nautical Almanac, and are reprinted in full. This dependency of American savans upon Europeans, must continue so

long as the country is destitute of the establishment of a nautical almanac of its own. The computations required exceed the means of any individual. The Lunar Ephemeris is of course only popular. Enough is given for the amateur. The practical navigator and astronomer must still resort to the British Nautical Almanac, or Blunt's reprint of the same, which alone would exceed the entire space here devoted to the calander and accompaniments. Mr. Downes has appended several useful tables for engineers; his tables for finding latitude and time by equal altitudes, for reduction to the meridian, for refractions, for measure of heights by the barometer, are all of the most approved construction, and such as a person engaged in field labor must find indispensable. The want of such tables in a portable form must, doubtless, have been felt by Mr. Downes, in the Boundary survey. The table for computing the heights of mountains by barometric observations, is taken from Bessel's paper in Schumacher's Astronomical Notices, vol. xv, Nos. 356 and 357, or rather from a reprint of the same, in a more popular form, in Schumacher's Jahrbuch, for 1840. Bessel's tables for computing heights by the barométer, have an important advantage over all the others that preceded them, in taking into account the degree of saturation of the atmosphere with vapor, or, in other words, the temperature of the dew point. The tables in use previous to Bessel's, were usually founded on Laplace's formulæ in the Mécanique Céleste. The simplest arrangement of the computation was contrived by Gauss, and has been reprinted by Baily in his "Astronomical Tables and Formulæ." These suppose a mean state of the atmosphere in respect to moisture, but make no allowance for the actual degree of saturation. Bessel's tables, when the mean condition of the atmosphere is supposed, agree very well with those of Gauss; but they go farther, and enable us to point out the correction required in the computed heights of stations for a rise or fall of the temperature of the dew point. As this subject is new to most of the readers of the Journal, we subjoin the following table, computed by Bessel, for the purpose of showing the maximum error which may arise from overlooking altogether the correction for the moisture of the atmosphere, or, in other words, the supposition of complete dryness.

An inspection of this table is sufficient to show the necessity of attending to this correction—for example, when the half sum of the temperatures is 68°, and the difference of altitude 10,000 feet, the maximum effect of a saturation with vapor on the result is 105 feet. The mean ordinarily used is 52.5 feet, which is the greatest error that can be committed in this case, by supposing the atmosphere to be in a mean state of moisture.

We have been led into this digression by the consideration of the importance of this element in the discussion of the meteorological registers recently published in this Journal.

Difference of Altitude in Toises.	Half Sum of the Temperatures of the Air, in Degrees of the Centigrade Thermometer.		
	0°	10°	20°
T.	T.	T.	T.
500	1.36	2.55	4.64
1000	2.90	5.41	9.83
1500	4.62	8.61	15.60
2000	6.55	2.18	22.02
2500	8.70	16.15	29.14
3000	11.10	20.55	37.02
Difference of Altitude in English feet.	The same for Fahrenheit.		
	32°	50°	68°
Feet.	Feet.	Feet.	Feet.
3197.3	8.70	16.31	29.67
6394.6	18.55	34.60	62.85
9593.2	29.54	55.06	99.76
12789.2	41.89	77,89	140.81
15986.5	55.64	103.27	186.33
19183.8	70.98	131.40	236.72

On the whole, we must conclude that the Ephemeris is the most complete manual for the surveyor, topographical engineer, and practical astronomer, that has yet appeared in this country, in a form suitable for the pocket.

The geographical and statistical part of the work fills the remaining two hundred pages, and gives a list of the principal cities, ports, naval and military stations, with their appropriate latitudes and longitudes, from the best and most recent authorities. Then follows the herculean work of a digest of the census of 1840; this has been effected from the general table of statistics published in folio by Congress, so as to give, under an alphabetical arrangement, every town, county, territory, and state, in the Union, that has a local habitation and a name, with their respective populations, according to this census. The work contains, also, an epitome of the *blue* book, and will be of great use to office-holders and expectants of office, under the federal, state, or municipal governments. Every post-officer whose salary exceeds $500 is mentioned, and the location of his post-office is given. Full information is furnished respecting foreign and home diplomatic agents, the principal officers of the army and navy list, the executive cabinets, the auditors, collectors, consuls, &c., and their salaries. The work also contains full tables relative to the commerce,

imports, and exports of the country, during the several presidential terms; the aggregate value, produce, capital invested, and persons employed, in every department of commerce, and manufactures, and produce of the country. These tables contain highly useful information; they have been compiled from the census returns made by the marshals of the several districts in the United States. Another important item—that of the state debts—is stated at full, with the date when, and purposes for which, they were contracted; the causes of the unprofitableness of the public works of some of the states, and of their success in others. The work also contains an estimate of the rate of increase of the population of the United States for every ten years, since 1790, with estimates for 1850, '60, and '70; thus it appears that the average ten year increase has been 34 [illegible]/100 per cent—at which rate the population would amount, in 1870, to about forty-one millions.

As the subject is one of great importance, and as it may be desirable to know the amount of our population at intermediate periods between the censuses, we have endeavored to deduce from a discussion of the six censuses from 1790 to 1840, inclusive, the most plausible analytical expression of this population, any year. The method employed consists in considering these six censuses as six terms of a series, of which the generating function is required.

Let P_n = the population of the United States at any date n.
P_m = the same at any other date m.
r_n = the rate of increase of the population for the year whose middle has the date n.

Then if we suppose r to vary according to the powers of the intervals in years $(m-n)$, we have between P_n and P_m the following equation:

$$(1) \cdots P_n = P_m \left(r_n + A\cdot(m-n) + B\cdot(m-n)^2 + C\cdot(m-n)^3 + \&c.\right)^{(m-n)}$$

or,

$$(2) \cdots \left(\frac{P_n}{P_m}\right)^{\frac{1}{m-n}} = r_n + A\cdot(m-n) + B\cdot(m-n)^2 + C\cdot(m-n)^3 + \&c.$$

in which, A, B, C, &c., are the unknown constant co-efficients of the successive powers of the interval $(m-n.)$ Giving to n the value of 1840, and to m the successive dates of the first five censuses, which we take from the table given by Mr. Downes, and which is reported below, and neglecting the third and higher powers of the interval $(m-n)$, on account of the smallness of the number of censuses, or terms of the series, we find, by means of the last formula,

$$\text{for } m = 1790;\; r_{1840} - 50\,A - 2500\,B = 1.0298086$$
$$= 1800;\; r_{1840} - 40\,A - 1600\,B = 1.0296412$$
$$(3) \qquad = 1810;\; r_{1840} - 30\,A - 900\,B = 1.0290009$$
$$= 1820;\; r_{1840} - 20\,A - 400\,B = 1.0289878$$
$$= 1830;\; r_{1840} - 10\,A - 100\,B = 1.0286688$$

Whence

$$v_0 = A + 90\,B + 1674\,.\,(10)^{-8}$$
$$v_1 = A + 70\,B + 6403\,.\,(10)^{-8}$$
$$v_2 = A + 50\,B + 131\,.\,(10)^{-8}$$
$$v_3 = A + 30\,B + 3190\,.\,(10)^{-8}$$

And by least squares

$$A = -7641\,.\,(10)^{-9} + 0.6728 \times \eta - 0.0098 \times \xi$$
$$B = -316\,.\,(10)^{-9} + 0.0000 \times \eta - 0.0098 \times \xi$$

These in No. (3) give

$$(r_n)_0 = 1.0286365$$
$$(r_n)_1 = 1.0288300$$
$$(r_n)_2 = 1.0284873$$
$$(r_n)_3 = 1.0287086$$
$$(r_n)_4 = 1.0285608$$
$$\text{Mean } r_n = 1.02864464 = r_{1840}$$

These values of r_n, A, and B, in No. (1), give for the population of the United States for any year denoted by m, the value of $P_m =$

$$17{,}068{,}666\,.\left[1.028644640 + 7641.(10)^{-9}\,(1840 - m) + 316.(10)^{-9}\,(1840 - m)^2\right]^{(m-1840)}$$

The following table contains the population of the United States for the decades from 1750 to 1900, inclusive, as derived from this formula, compared with the actual census. A formula which, reckoning backwards from 1840 to 1790, represents the population of the United States, with a maximum error of 38,000, and with a sum of errors of 95,000, in an aggregate of 56,000,000, must afford a plausible estimate for two or three censuses to come. It is impossible by the censuses before and since 1800, and 1810, to interpolate the values of the two latter. Can it be that the disturbed state of Europe and the West Indies, from 1790 to 1800, caused an excess of immigration to the United States of about 40,000, of which the greater part returned, under the more settled and consolidated governments from 1800 to 1810? Can any portion of the emigration, or falling off of the immigration in the latter period, be attributed to the restrictions upon commerce incident to the state of the times and to our domestic policy? We leave the subject to the decision of political economists.

Date.	POPULATION OF THE UNITED STATES.		
	By Census.	By Formula.	Discrepancy.
1750		1,015,000	
1760		1,455,000	
1770		2,054,000	
1780		2,859,000	
1790	3,929,827	3,928,000	— 2,000
1800	5,305,940	5,344,000	+ 38,000
1810	7,239,814	7,207,000	— 33,000
1820	9,638,191	9,650,000	+ 12,000
1830	12,866,020	12,856,000	+ 10,000
1840	17,068,666	17,068,666	0.000
1850		22,629,000	
1860		30,007,000	
1870		39,890,000	
1880		53,200,000	
1890		71,000,000	
1900		97,000,000	

Physical Science.

On the Chemical Statics of Organized Beings. *By* M. Dumas.

[CONTINUED FROM PAGE 92.]

III. Let a seed be thrown into the earth, and be left to germinate and develope itself; let the new plant be watched until it has borne flowers and seeds in its turn, and we shall see, by suitable analyses, that the primitive seed, in producing the new being, has fixed carbon, hydrogen, oxygen, azote, and ashes.

Carbon.—The carbon originates essentially in carbonic acid, whether it be borrowed from the carbonic acid of the air, or proceed from that other portion of carbonic acid which the spontaneous decomposition of manures continually gives out in contact with the roots.

But it is from the air especially that plants most frequently derive their carbon. How could it be otherwise, when we see the enormous quantity of carbon which aged trees, for example, have appropriated to themselves, and yet the very limited space within which their roots can extend? Certainly, when a hundred years ago the acorn germinated, which has produced the oak that we now admire, the soil on which it fell did not contain the millionth part of the carbon that the oak itself now contains. It is the carbonic acid of the air which has supplied the rest, that is to say, nearly the whole.

But what can be clearer and more conclusive than the experiment of M. Boussingault, in which peas, sown in sand, watered with distilled water, and having no aliment but air, have found in that air all the carbon necessary for development, flowering, and fructification?

All plants fix carbon, all borrow it from carbonic acid; whether this be taken directly from the air by the leaves, whether the roots imbibe within the ground the rain water impregnated with carbonic acid, or whether the manures, whilst decomposing in the soil, supply carbonic acid, which the roots also take possession of to transmit it to the leaves.

All these results may be proved without difficulty. M. Boussingault observed that vine leaves which were enclosed in a globe took all the carbonic acid from the air directed across the vessel, however rapid the current. M. Boucherie also observed enormous quantities of carbonic acid escape from the divided trunk of trees in full sap, evidently drawn by the roots from the soil.

But if the roots imbibe this carbonic acid within the earth, if this passes into the stalk and thence into the leaves, it ends by being exhaled into the atmosphere, without alteration, when no new force intervenes.

Such is the case with plants vegetating in the shade or at night. The carbonic acid of the earth filters through their tissues, and diffuses itself into the air. We say that plants produce carbonic acid during the night; we should say, in such a case, that plants transmit the carbonic acid borrowed from the soil.

But let this carbonic acid, proceeding from the soil or taken from the atmosphere, come into contact with the leaves or the green parts, and let the solar light, moreover, intervene, then the scene all at once changes.

The carbonic acid disappears; bubbles of free oxygen arise on all the parts of the leaf, and the carbon fixes itself in the tissues of the plant.

It is a circumstance well worthy of interest, that these green parts of plants, the only ones which up to this time manifest this admirable phenomenon of the decomposition of carbonic acid, are also endowed with another property not less peculiar, or less mysterious.

In fact, if their image were to be transferred into the apparatus of M. Daguerre, these green parts are not found to be reproduced there; as if all the chemical rays, essential to the Daguerrian phenomena, had disappeared in the leaf, absorbed and retained by it.

The chemical rays of light disappear, therefore, entirely in the green parts of plants; an extraordinary absorption, doubtless, but which explains, without difficulty, the enormous expense of chemical force necessary for the decomposition of a body so stable as carbonic acid.

What, moreover, is the function of this fixed carbon in the plant? for what is it destined? For the greater part, without doubt, it combines with water or with its elements, thus giving birth to matters of the highest importance for the vegetable.

If twelve molecules of carbonic acid are decomposed and abandon their oxygen, the result will be twelve molecules of carbon; which, with ten molecules of water, may constitute either the cellular tissue of plants, or their ligneous tissue, or the starch and the dextrine which are produced from them.

Thus, in any plant whatever, nearly the entire mass of the structure, (charpente,) formed as it is of cellular tissue, of ligneous tissue, of starch, or of gummy matters, will be represented by twelve molecules of carbon united to ten molecules of water.

The ligneous part which is insoluble in water, the starch, which gelatinises (l'amidon, qui fait empois) in boiling water, and the dextrine which dissolves so easily in water cold or hot, constitute, therefore, as M. Payen has so well proved, three bodies possessing exactly the same composition, but diversified by a different molecular arrangement.

Thus, with the same elements, in the same proportions, vegetable nature produces the insoluble walls of the cells of cellular tissue and of the vessels, or the starch which she accumulates as nourishment around buds and embryos, or the soluble dextrine which the sap can convey from one place to another for the wants of the plant.

How admirable is this fecundity, which out of the same body can make three different ones, and which allows of their being changed one into the other, with the slightest expense of force, every time occasion requires it!

It is also by means of carbon united with water, that the saccharine matters so frequently deposited in the organs of plants for peculiar purposes, which we shall shortly mention, are produced. Twelve molecules of carbon and eleven molecules of water form the cane sugar. Twelve molecules of carbon and fifteen molecules of water make the sugar of the grape.

These ligneous, amylaceous, gummy, and saccharine matters, which carbon, taken in its nascent state, can produce by uniting with water, play so large a part in the life of plants, that, when they are taken into consideration, it is no longer difficult to understand the important part that the decomposition of carbonic acid performs in plants.

Hydrogen.—In the same manner that plants decompose carbonic acid for the appropriation of its carbon, and in order to form together with it all the neutral bodies which compose nearly their entire mass; in the same way, and for certain products which they form in less abundance, plants decompose water and fix its hydrogen. This appears clearly from M. Boussingault's experiments on the vegetation of peas in closed vessels. It is still more evident from the production of fat or volatile oils so frequent in certain parts of plants, and always so rich in hydrogen. This can only come from water, for the plant receives no other hydrogenated product than the water itself.

These hydrogenated bodies, to which the fixation of the hydrogen borrowed from the water gives birth, are employed by plants for accessory uses. They form, indeed, the volatile oils which serve for defence against the ravages of insects; fat oils or fats, which surround the seed, and which serve to develope heat by oxidation (en se brûlent) at the moment of germination; waxes with which leaves and fruits are covered so as to become impermeable to water.

But all these uses constitute some accidents only in the life of plants: thus the hydrogenated products are much less necessary, much less

common, in the vegetable kingdom, than the neutral products formed of carbon and water.

Azote.—During its life, every plant fixes azote, whether it borrows the azote from the atmosphere, or takes it from the manure. In either case it is probable that the azote enters the plant, and acts its part there only under the form of ammonia or of nitric acid.

M. Boussingault's experiments have proved that certain plants, such as Jerusalem artichokes, borrow a great quantity of azote from the air; that others, such as wheat, are, on the contrary, obliged to derive all theirs from manure: a valuable distinction for agriculture; for it is evident that all cultivation should begin by producing vegetables which assimilate azote from air, to rear by their aid the cattle which will furnish manure, and employ this latter for the cultivation of certain plants which can take azote from the manures only.

One of the most interesting problems of agriculture consists, then, in the art of procuring azote at a cheap rate. As for carbon, no trouble need be taken about it; nature has provided for it; the air and rain water suffice for it; but the azote of the air, that which the water dissolves and brings with it, the ammoniacal salts which rain water itself contains, are not always sufficient. With regard to most plants the cultivation of which is important, their roots should also be surrounded with azotated manure, a permanent source of ammonia or of nitric acid, which the plant appropriates as they are produced. This, as we know, is one of the great expenses of agriculture, one of its great obstacles, for it possesses only the manure which is of its own production. But chemistry is so far advanced in this respect, that the problem of the production of a purely chemical azotated manure cannot be long in being resolved.

M. Schattenman, the skilful director of the manufactories of Bouxvilliers in Alsace, M. Boussingault, and M. Liebig have turned their attention to the functions of ammonia in azotated manures. Recent trials show that the nitric acid of the nitrates also merit particular attention.

But for what purpose is this azote, of which plants seem to have such an imperious want? M. Payen's researches partly teach us; for they have proved that all the organs of the plant, without exception, begin by being formed of an azotated matter analogous to fibrine, with which at a later period are associated the cellular tissue, the ligneous tissue, and the amylaceous tissue itself. This azotated matter, the real origin of all the parts of the plant, is never destroyed; it is always to be found, however abundant may be the non-azotated matter which has been interposed between its particles.

This azote, fixed by plants, serves, therefore, to produce a concrete fibrinous substance, which constitutes the rudiment of all the organs of the vegetable.

It also serves to produce the liquid albumen which the coagulable juices of all plants contain; and the caseum, so often confounded with albumen, but so easy to recognise in many plants.

Fibrin, albumen, and caseum exist, then, in plants. These three products, identical in their composition, as M. Vogel has long since

proved, offer a singular analogy with the ligneous matters, the amidon, and the dextrine.

Indeed, fibrin is, like ligneous matter, insoluble; albumen, like starch, coagulates by heat; caseum, like dextrine, is soluble.

These azotated matters, moreover, are neutral, as well as the three parallel non-azotated matters; and we shall see that by their abundance in the animal kingdom they act the same part that these latter exhibited to us in the vegetable kingdom.

Besides, in like manner as it suffices for the formation of non-azotated neutral matters, to unite carbon with water or with its elements, so, also, for the formation of these azotated neutral matters, it suffices to unite carbon and ammonium with the elements of water; forty-eight molecules of carbon, six of ammonium, and seventeen of water, constitute, or may constitute, fibrin, albumen, and caseum.

Thus, in both cases, reduced bodies, carbon or ammonium, and water, suffice for the formation of the matters which we are considering, and their production enters quite naturally into the circle of reactions, which vegetable nature seems especially adapted to produce.

The function of azote in plants is therefore worthy of the most serious attention, since it is this which serves to form the fibrin which is found as the rudiment in all the organs; since it is this which serves for the production of the albumen and caseum, so largely diffused in so many plants, and which animals assimilate or modify according to the exigencies of their own nature.

It is in plants, then, that the true laboratory of organic chemistry resides. Thus, carbon, hydrogen, ammonium, and water are the principles which plants elaborate: ligneous matter, starch, gums, and sugars on the one part, fibrin, albumen, caseum, and gluten on the other, are, then, the fundamental products of the two kingdoms; products formed in plants, and in plants alone, and transferred by digestion into animals.

Ashes.—An immense quantity of water passes through the vegetable during the period of its existence. This water evaporates at the surface of the leaves, and necessarily leaves, as residue, in the plant the salts which it contained in solution. These salts compose the ashes, products evidently borrowed from the earth, to which, after their death, vegetables give it back again.

As to the form in which these mineral products deposit themselves in the vegetable tissue, nothing can be more variable. We may remark, however, that among the products of this nature, one of the most frequent and most abundant is that pectinate of lime discovered by M. Jacquelain in the ligneous tissue of most plants.

IV. If, in the dark, plants act as simple filters which water and gases pass through; if, under the influence of solar light, they act as reducing apparatus which decompose water, carbonic acid, and oxide of ammonium, there are certain epochs and certain organs in which the plant assumes another, and altogether opposite, part.

Thus, if an embryo is to be made to germinate, a bud to be unfolded, a flower to be fecundated, the plant which absorbed the solar heat, which decomposed carbonic acid and water, all at once changes its

course. It burns carbon and hydrogen; it produces heat; that is to say, it takes to itself the principal characters of animal life.

But here a remarkable circumstance reveals itself. If barley or wheat is made to germinate, much heat, carbonic acid and water are produced. The starch of these grains first changes into gum, then into sugar, then it disappears in producing carbonic acid, which the germ is to assimilate. Does a potato germinate, here, also, it is starch which changes into dextrine, then into sugar, and which at last produces carbonic acid and heat. Sugar, therefore, seems the agent by means of which plants develope heat as they need it.

How is it possible not to be struck from this with the coincidence of the following facts? Fecundation is always accompanied by heat. Flowers as they breathe produce carbonic acid: they therefore consume carbon; and if we ask whence this carbon comes, we see, in the sugar cane, for example, that the sugar accumulated in the stalk has entirely disappeared when the flowering and fructification are accomplished. In the beet root, the sugar continues increasing in the roots until it flowers; the seed-bearing beet contains no trace of sugar in its root. In the parsnip, the turnip, and the carrot, the same phenomena take place.

Thus, at certain epochs, in certain organs, the plant turns into an animal; it becomes, like it, an apparatus of combustion; it burns carbon and hydrogen; it gives out heat.

But, at these same periods, it destroys in abundance the saccharine matters which it had slowly accumulated and stored up. Sugar, or starch turned into sugar, are, then, the primary substances by means of which plants develope heat as required for the accomplishment of some of their functions.

And if we remark with what instinct animals, and men too, choose for their food just that part of the vegetable in which it has accumulated the sugar and starch which serve it to develope heat, is it not probable, that, in the animal economy, sugar and starch are also destined to act the same part, that is to say, to be burned for the purpose of developing the heat which accompanies the phenomenon of respiration?

To sum up, as long as the vegetable preserves its most habitual character, it draws from the sun heat, light, and chemical rays; from the air it receives carbon; from water it takes hydrogen; azote from the oxide of ammonium, and different salts from the earth. With these mineral or elementary substances, it composes the organised substances which accumulate in its tissues.

They are ternary substances, ligneous matter, starch, gums, and sugars.

They are quaternary substances, fibrin, albumen, caseum, and gluten.

So far, then, the vegetable is an unceasing producer; but if at times, if to satify certain wants, the vegetable becomes a consumer, it realises exactly the same phenomena which the animal will now set before us.

[TO BE CONTINUED.]

Description of an Electric Thermometer. *By* E. SOLLY, *Jun.*, *Esq.*

I am induced to send the following account of a little thermo-electric arrangement, believing that it may be interesting; for although there is little or no novelty in the principles on which its action depends, I am not aware that it has been before practically employed.

I had for some time experienced considerable inconvenience in conducting certain experiments requiring a long-continued and uniform degree of heat, from the difficulty of regulating the temperature of my furnace, and the constant uncertainty whether everything was proceeding satisfactorily during my absence from the laboratory. I had, in consequence, often thought of the possibility of so arranging a little thermo-electric apparatus, that it might serve as an index of the rate of combustion and consequent heat of the furnace, by the deflection of a galvanometer at a distance from the source of heat. A small thermo-electric battery might be so placed that the one series of joints, or solderings, should be constantly exposed to the heated surface of the furnace; but a serious obstacle presented itself to any contrivance of this kind, which was, the difficulty of keeping the alternate joints of the battery cool. A current of electricity would doubtless be evolved, in consequence of the difference of temperature existing between the two sides of the battery; but, of course, as the heat would gradually traverse from the hotter to the cooler side, it would greatly diminish and modify the results, and thus present false indications of temperature—whilst even if it were possible to keep the one side of the battery cool, either by water or by any other means, yet the value of the deflection of the galvanometer would be always uncertain, as the difference between the two sides of the battery could never be ascertained unless the exact reduction of temperature thus caused were correctly known.

After one or two unsuccessful attemps to overcome this objection, I laid aside the battery, and substituted in its place a single pair of metallic elements, which I found gave abundance of power, and was not liable to the defect which the use of the battery involved.

A piece of copper wire, one-twenty-fourth of an inch in diameter, and of sufficient length to reach from the furnace to my ordinary sitting room, was joined by twisting the ends to a similar wire of soft iron—the ends of both having been previously well cleaned with sand paper. The two wires were then secured in a convenient manner, by small nails, to the walls of the rooms they had to pass through, care being taken that they were not anywhere in contact with each other, except at the two extreme points of junction; the one of these was so placed in the flue of the furnace that it was completely exposed to the action of the hot air and smoke at that part where the flue left the body of the furnace, whilst the other joint was in my room, in contact with a thermometer and surrounded with cotton, so as to render it as little as possible liable to sudden changes of temperature. The copper wire was then divided about a foot from the joint thus protected. The two ends of the wire were connected with the extremities of a galvanometer coil, and the apparatus was complete.

A metallic circuit was thus made, consisting of two elements—the one being the iron wire, and the other the copper wire, including the additional length of copper wire in the coil of the galvanometer. The one joint, or point of contact, was, of course, always far hotter than the other, and would necessarily remain so, so long as the fuel in the furnace continued to burn, and would be dependent on the rate of combustion in the furnace; whilst the other junction would always remain very nearly at the temperature of the air, and its variations could be readily known by the thermometer in contact with it. A current of electricity was thus generated, proportioned to the difference of temperature between the two joints, and a deflection of the galvanometer was caused, which increased when the furnace became hotter, decreased when it cooled, and at all times indicated accurately the changes of temperature taking place—thus giving me a thermometer which indicates, without my moving from the table, the exact rate of combustion going on in the furnace, which is fifty yards distant from the indicator. I believe that it is commonly supposed that weak thermo-electric currents cannot be well made to traverse small wires of any length, and this is probably the reason why this beautifully manageable power has been so little employed for practical uses. I have received so much satisfaction from the arrangement just described, that I am convinced it would be found a very useful indicator of temperature in stoves, flues, and hot pipes, in many situations where a common thermometer is inapplicable.

The cost of such an apparatus must necessarily be more expensive than any thermometer, but then it must be remembered that it does far more than an ordinary thermometer, giving us the means of knowing the temperature of a stove, or furnace, at a distance; giving us indications of the least change or variation in the source of heat, with even greater certainty and distinctness than a thermometer; and besides, showing these changes so rapidly, that we know whether it is becoming hotter or colder, before a thermometer, placed on the outside of the stove, indicates any change. I have observed, on comparing the thermo-electric with an ordinary thermometer, placed on the iron plate forming the top of the furnace, that if the ash-pit door were closed, or the draught in any other way diminished, the deflection of the galvanometer was immediately reduced, whilst the external thermometer continued to rise for some little time; and that the indications given by the galvanometer of the augmentation or decrease of temperature in the furnace, always preceded the same indications from the mercurial thermometer on the top.

London, October 20, 1841. Lond. & Ed. Philos. Mag.

On the Mouths of Ammonites, and on other Fossils, found in the Oxford Clay, near Christian Malford, on the Line of the Great Western Railway. By Mr. C. Pearce.

The section exhibited at the point where Mr. Pearce obtained his specimens was at follows:

1. Alluvial soil, ... 2 feet.
2. Gravel, ... 8 "
3. Beds of laminated clay, alternating with layers of sandy clay, chiefly composed of broken shells, . 6 "

The fossils described in the paper were procured from No. 3, and consisted of crustaceans, which the author conceives inhabited the dead shells of the Ammonite, and to which he applies the generic name of Ammonicolax, of numerous bivalves and univalves, of Ammonites, with the mouths beautifully preserved, Belemnites, and an allied genus, for which he proposes the name of Belemnoteuthis. Of many of these fossils detailed specific characters are given, but as they do not admit of abridgement, we must confine our notice to the author's remarks on the structure of the mouth of the ammonite. Mr. Pearce is of opinion that the lip, or perfect termination, assumes a different shape in almost every species, and that it has a simpler form in the adult, or full grown shell, than in immature individuals. For several years he has remarked, that specimens of what he considered to be full grown ammonites, with a perfect lip, had a nearly straight, or slightly waved, margin, whilst smaller, and as he conceives younger, shells, of the same species, possessed, in many instances, lateral prolongations, equalling, occasionally, in length, as he has recently observed, five-sixths of the diameter of the fossil. During the growth of the shell these processes, he is of opinion, were successively absorbed and reproduced, but were never added to the final lip. From an extended examination of ammonites belonging to various rocks, Mr. Pearce infers, that in the young shell, provided with lateral projections, the animal filled not merely the whole of the last chamber, but extended beyond it, and thereby guarded the processes from injury, and received support, or protection, from them. On the contrary, the last chamber of the mature shell having been, he believes, sufficiently large to receive the whole of the soft parts of the animal, the lateral appendages were not required, and, consequently, were not added to the lip. In the course of the paper, some remarks were offered on other species of ammonites, which apparently never possessed lateral processes at any period of growth, but are characterized by contractions, or expansions, of the shell, at certain points; and in those cases, Mr. Pearce concludes that the additions were made without the absorption of the old mouths.—*Transactions Geolog. Soc.*

Athenæum.

Notice of the Occurrence of Fossil Plants in the Plastic Clay at Bournemouth, Hants. By the Rev. P. B. Brodie.

To the east of Bournemouth, the cliffs consist of white and yellow sands belonging to the plastic clay, and as they range along the shore they increase in height—beds of clay, full of vegetable remains, appearing under the sands. About half a mile from this point they are composed of alternations of white, grey, and yellow, sand, overlaid by strata of clay, divided by thin layers of vegetable matter. In a bed of white sand, near the middle of the cliff, are impressions of

ferns; and a layer of sandy clay is full of small leaves. Somewhat farther, are strata of sand and sandy clay, abounding with beautiful vegetable remains. The plants are frequently so well preserved that the epidermis peels off when the specimen is exposed, and they are stated, by the author, to belong to genera of a warmer climate than that which now prevails in Great Britain. Ibid.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Fire Engines;* Joseph B. Babcock, Marietta, Washington county, Ohio, July 1.

The cylinders and pistons, or plungers, are placed horizontally, and these cylinders, with the part of the apparatus to which they are attached, are secured down to the bottom of the cistern. The pistons, or plungers, are hollow, and are provided with valves for the admission of the water into the cylinders; they are attached to the ends of a square frame, inside, the side pieces of which are provided with racks, into which the teeth of two segment cog wheels work, said segments being attached to the brake.

Claim.—"What I claim is the manner in which I have constructed, arranged, and combined, two horizontal hollow pistons, with the horizontal cylinders affixed to the bottom of the cistern of a fire engine, and also with the vibrating frame and segment wheels; the whole being constructed and operating as set forth. I do not claim either of these parts separately and individually, but I do claim so to have combined them as to produce an instrument new in its construction, and useful in its operation."

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2. For an improvement in the *Bee Hive;* John M. Weeks, Salisbury, Addison county, Vermont, July 1.

"What is claimed as constituting the invention, and not previously known in bee hives, is the mode of regulating the ventilation of the hive by means of tubes lined with wire gauze, and having apertures to which the adjustable caps, perforated with similar apertures, are adapted; the whole being constructed in the manner set forth. Also, combining with the central box, or line, one or more collateral boxes, containing smaller hives, in combination with the mode of ascertaining and regulating the temperature of the hives, by means of thermometrical and ventilating apparatus; the whole being constructed, and operating, substantially in the manner described."

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3. For an improvement in the *Horse Power;* Thomas J. Wells, New York city, July 1.

This horse power is actuated by belts, instead of by cog wheels; the horse sweep turns on a centre pin, in the middle of a circular

platform, around which a band passes, that extends to, and around, a small wheel, the axle of which has its bearings near the outer extremity of the sweep. On the upper end of this axle there is a band wheel, from which a band extends to a small wheel, turning on the same pin with the horse sweep; connected to this small wheel, and turning with it, there is a large wheel, from which a band extends to any machine to be driven.

Claim.—"I do not claim as my invention the mere substitution of a band for cogged wheels, in the construction of a horse power; nor do I claim simply placing the double wheels on the horse sweep, or lever, to travel around the main, or stationary, wheel, as this has been heretofore done with cog wheels having the axis of the traveling wheels within the periphery of the main wheel, the cogs of which were put on the inner periphery thereof; but what I do claim as my invention, and desire to secure by letters patent, is placing the traveling wheels on the sweep without the periphery of the main, or stationary, wheel, in combination with the employment of bands, as herein described."

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4. For improvements in the *Steam Boiler and Evaporator;* Oran W. Seely, New York city, July 1.

This patent is obtained for an improvement on a steam boiler, or evaporator, patented to the said Seely, and Dudley Marvin, on the 28th of August, 1840, and noticed in this Journal, at page 264, vol. ii, 3rd series—by a reference to which notice, the nature of the improvement, as embraced in the following claim, will be readily understood.

Claim.—"What I claim, and desire to secure by letters patent, is, first, the manner of forming the stay bolts in the respective cells, by means of cores, sustained upon a grating of iron, constructed in the manner set forth; said cores having holes bored through them whereever stay bolts are required to cross the cells; the respective parts being arranged in the manner, and for the purpose, [to give sufficient strength to resist the force of high steam,] set forth. And, secondly, I claim the sustaining of the body of the boiler, by means of iron pieces, crossing from side to side, and bolted through the plates forming the upper part of the division between the cells, as above described. I also claim the use of such bridge pieces, in the same manner, and for the same purpose, whether the body of said boiler be formed of cast iron, in one entire piece, or of sheet metal, by riveting the same together in the ususl way."

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5. For an improvement in the *Canal Lock;* Robert English, Lagro, Wabash county, Indiana, July 1.

The patentee calls this "the air and water-acting sympathetic canal lock gate."

At the upper end of the lock, which is the subject of this patent, there is to be an air-tight chamber, provided with what the patentee calls "sympathetic gates," which are hinged to the lock in such a manner as to shut one upon the other, the lowermost being provided with [illegible]-tight float. Below these two gates there are two valves, one of

which communicates with the water in the upper chamber of the lock, and the other with a culvert leading to a lower level. When the first named valve is opened, the chamber below the gates is filled with water, which, acting on the float, forces up the gates, and thus closes the lock; and when this valve is closed, and that leading to the culvert opened, the water running out of the chamber to a lower level, leaves a partial vacuum below the gates, which are consequently forced down by the pressure of the atmosphere, aided by their own gravity; a communication is thus opened between the upper and lower levels. Where the water discharges from the upper to the lower level, there is a breakwater attached by hinges to the lock, to prevent the water from rushing too suddenly on to the boat in the lower lock.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the vertically moving gates and air-float, in combination with the chamber, trunks, or culverts, and valves, as a substitute for the common horizontally moving gates—said gates being opened and closed by the combined action of air and water, in the manner set forth, or any other substantially the same. I also claim, in combination with the foregoing, the self-acting breakwater, as described."

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6. For an improvement in the mode of *Fastening Scythes to Snaths;* Silas Lamson, Shelburn Falls, Berkshire county, Massachusetts, July 1.

The first item claimed is a mode of securing the blade to the snath, by means of a metallic saddle, fitted to the lower end of the snath, which saddle receives a shank at the heel of the blade, in combination with the mode of securing the two plates together, either by means of two cam bolts, which pass through slots in the saddle, and which, when turned, secure the shank, or by a spring-catch, which catches in a notch made for that purpose, in that part of the shank which passes through, and extends beyond, the saddle. The second item of the claim is to another mode of securing the blade to the snath, by slitting the heel end of the blade, and turning one part at right angles thereto, and "securing these portions to the snath by screws, one of which has a large flat head to lap over the blade and over the shank, which is placed in an oblong mortise in the turned-up end of the blade, to allow of its being regulated." The third item is also for securing the blade to the snath, by "rendering the heel end of the blade concave, to fit the convex end of the snath, and turning a portion over the back of the snath, and a portion at right angles against the front of it, and securing the blade by screw-bolts, placed in oblong slots, by which the blade can be set at pleasure, as described." The fourth item is for accomplishing the same end by simply passing the bolts, by which the whole is secured, through oblong slots in the heel of the blade, by which it is said that "the blade can be adjusted easily, without removing the screws from the snath, by simply loosening them, and adjusting the blade on the shanks by means of the oblong slots." The fifth item is for securing the nibs to the snath "by form-

ing the two ends of the bar which surrounds the snath into a shank, and perforating the same with oblong apertures, to admit wedges, or keys, which pass through the nib and said apertures, for drawing the snath home to the nib." The sixth item is for effecting the object named in the fifth section, by the combination of a square snath, a saddle at the end of the nib, which rests on one of the angles of the snath, and a bolt, which passes through the whole.

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7. For improvements in the combined *Cooking and Air-heating Stove;* Alex. F. Bean, Woodstock, Windsor county, Vermont, July 8.

The claim under this patent is so full, that it needs no additional explanation.

Claim.—"I claim the manner of constructing the swinging hearth, so that the two sections thereof may both be turned entirely back, under and behind the back plate of the stone, and so that each section of it shall have on it a plate, or piece, so formed that when in place, these two pieces will cover, and entirely close, the opening situated beneath and between the vertical grate bars, and leading into the fire chamber; by which device, when the vertical grate bars are also closed, the fire chamber will become that of a close stove, and must receive its supply of air from without the room, in the manner set forth. I claim the mode in which I have combined a tin reflector with my stove, by hinging the same, or causing it to work upon joint pins, in such manner as that it may be turned up, and will, in combination with the sunk hearth, entirely inclose the opening in front of the stove, and that when turned down it will pass beneath the sunk hearth, and be entirely out of the way. I claim the manner of constructing the vertical grate bars in front of the fire, so that they shall consist of flat plates, or slots, hung upon pivots, and be capable of being simultaneously and entirely closed by bringing them into the same plane with each other, in the manner set forth. I claim the placing of the hinged grated piece so that it may be turned up to inclose in part the space, when necessary, and thus to prevent the falling of coals from the fire chamber; and which grated piece may be turned down, so as to be received within the sunken hearth. I claim the constructing of the grate below the fire, and which supports the fuel in the fire chamber, so that it may be raised up and throw the fuel upon the dead plate below it, for the purpose of being covered, to preserve it in a state of ignition. I claim the manner of arranging the parts concerned in supplying air to the fuel, when the front of the stove is inclosed; said arrangement consisting of the tube, or pipe, the air tube, extending along the lower and hind part of the chamber of combustion, and the device by which it is governed at one end by a sliding shutter; the whole being combined and operating substantially as set forth. I claim the manner of constructing and combining the respective parts of the air-heating apparatus, as set forth; the said apparatus consisting mainly of two cylinders with a space between them, inclosing within them a spiral flue, for the passage of heated

air from the fire, through which flue pass a number of vertical air tubes, which are supplied with cold air from without the apparatus, as is also the space between the two inclosed cylinders—the same operating by an arrangement of parts such as is made known; there being in the centre of said air-heater a descending flue, for conducting the smoke, &c., to the exit pipe, and an arrangement, such as herein set forth, for allowing the heated air from the fire to pass directly to the exit pipe, without entering the spiral flue. I claim the manner of constructing the oven above the air-heater, as set forth, so that the heated air may be passed back and forth through it when baking is to be effected, or may be made to pass directly up into distribution tubes without entering the oven; this being effected by an arrangement of parts substantially as set forth."

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8. For an improvement in the Endless Chain *Horse Power*, for driving Machinery; William C. Wheeler and Alonzo Wheeler, Columbia, Chatham county, New York, July 8.

The lower edge of the links of the chains, which receive the boards that form the endless floor for the horse, or horses, to tread on, are provided with cogs that take into pinions on a shaft, placed across the frame of the machine, to communicate motion to a thrashing, or other machine to be driven.

Claim.—"We are aware that endless chains for horse powers have been invented with plates joined together, and having cogs projecting from their under side, to act on a pinion, and, therefore, we do not claim this as our invention; but what we do claim, and desire to secure by letters patent, is providing the lower edge of the links of the chain, to which the endless flooring is attached, with cogs, to work into pinions, as described."

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9. For a machine for *Cutting Dovetails and Tenons;* Thomas J. Wells, city of New York, July 8.

The construction of this machine exhibits much mechanical skill. The cutters are attached to the periphery of a wheel on the end of a mandrel, and the wood to be tenoned is put on to a second mandrel, parallel to the first, the two being made to turn in the same direction, and with equal velocities. If the tenon is to be of four sides, four cutters are so arranged as to divide the periphery of the cutter wheel into four equal parts; and if the tenon is to be cut on two sides only, then two cutters are employed, and placed opposite to each other. As the cutters revolve they gradually approach the axis of the second mandrel, on which the wood is placed, until they reach a line passing through the axis of the two mandrels, and then they gradually recede from it. Although by means of drawings and diagrams the action of this apparatus might be rendered perfectly clear, it would not be easily understood from mere verbal description, and we shall not therefore attempt it.

Claim.—"The invention claimed, and desired to be secured by let-

ters patent, is the before-described mode of cutting tenons, or dovetails, or other forms, by a similar, simultaneous, rotary motion of the circular plane, and substance on which the tenon, dovetail, or other form, is to be made; the cutting being performed on an increment tangential line to the circumference of the revolving circular plane, whilst the cut made forms the chord line of a segment, on the piece of the circular rail cut away by the revolving cutter.

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10. For an improvement in the *Smut Mill;* Charles D. Childs, York, Livingston county, New York, July 8.

The patentee observes that the "Nature of his invention consists in cleaning damp wheat by throwing a heavy blast of air, with an inclined curved fan, through a column of wheat passing through revolving spikes of cast iron, that all dust and smut may escape through a case, or cylinder, of cast iron rings, having annular openings."

On the same shaft that carries the spikes, mentioned above, a fan is attached below them, said fan consisting of two inclined wings which force a current of wind upwards through the grain as it descends, and blow the chaff out through inclined tubes, or pipes, attached to the case. Below the fan, and on the same shaft with it, is a scouring wheel, with teeth like those of a corn mill. The grain is fed in at the top, and passes down between the revolving spikes, around the fan, and then down to the scourers.

Claim.—"I do not claim the combination of a revolving fan and beaters with a perforated case, or cylinder, as set forth, the fan being arranged below the beaters; nor do I claim the combination of a hopper with a revolving and stationary runner, inclosed in a case, the hopper being arranged above the revolving runner. What I claim is combining those two arrangements, in the manner set forth, the perforated case containing the beaters and fan being placed above that containing the hopper and runners, arranged in the manner described; the revolving runner being placed on the same shaft with the fan and beaters, and the bottom of the case containing the latter provided with spouts for carrying off the dust, and apertures to admit air to the fan, all as set forth."

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11. For an improvement in the *Pump;* C. D. Van Allen, Petersburg, Dinwiddie county, Virginia, July 8.

That part of the pump in which the piston works is made of iron, and the main body of wood, the sections being connected together by screws cut, or cast, on the ends of the iron part, and screwing into the wood; or, by having a metal socket screwed into the wood, and adapted to receive the male screw on the end of the iron section. The lower valve seat is flat, as is also the face of the valve, which is covered with a disk, or ring, of leather; and instead of being hinged in the usual way, it works up and down, in the manner of a puppet valve, guide pieces, or rods, which project from its lower side, serving to direct it properly.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the combining and connecting together of the wooden and metallic parts thereof, by means of cast metal coupling screws, or boxes, screwed into the wood, for the purpose, and in the manner, set forth; and I also claim the manner of constructing the lower valve, the whole being constructed and operating substantially as described."

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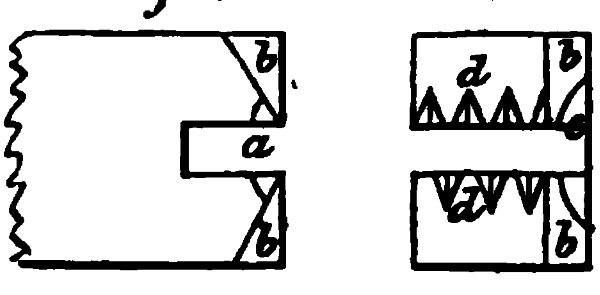
12. For improvements in machinery for *Cutting the Threads on Wood Screws;* Farwell H. Hamilton, Schenectady, New York, July 8.

In this machine there are two spindles, each carrying cutting dies; these spindles are placed side by side, and parallel to each other; each of them carries a pinion that takes into the teeth of a cog wheel placed between them, said cog wheel receives a reciprocating motion from a rack connected with, and moved back and forth by, a crank. The opening and closing of the dies, and the receding and advancing of the spindles, to form the thread, are effected as in some other screw machines. In front of the die end of each spindle there is a feeding wheel, with appropriate jaws for receiving and holding the blanks; an oil tube for supplying oil to the dies whilst cutting, is attached by the middle to a rocking shaft, which is connected with one of the spindles, that as they are turned in opposite directions, and as one is advancing and cutting the thread on a screw, and the other is retreating, the oil tube is shifted to supply the oil to the dies that are in the act of cutting. The dies are made in the manner represented in diagram 1 and 2. They have a nick in the end *a*, of sufficient depth to make the thread deep enough, without having the dies come together. They are then filed away, beveling on each side from the nick, excepting the leaving a lip, *b*, *b*, in which there is a countersink, *c*, to enable it to run readily on to the blank. After these dies are put into their places, a tap is run in, which, instead of cutting threads on them, cuts the teeth, *d*, *d*.

Fig. 1. 2.



Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st. The arrangement of machinery which operates the oil tube, and its combination with the machinery which gives to the spindles an opposite and alternate rotary motion, in the manner, and for the purpose, described. 2d. The method herein described of making the cutting part of the dies with teeth instead of a thread, in combination with the lips, as above described."

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13. For an improvement in the *Smut Machine,* for Cleaning Wheat, &c.; Henry A. Buck, Fredonia, Chautauque county, New York, July 10.

The outer case of this smut machine is cylindrical, the inner sur-

face being fluted, and within this revolves a set of beaters, which are attached, at top and bottom, to an annular ring, the lower one only being attached to the shaft by arms. Within this set of beaters there is a stationary cylinder, or cage, made of square or triangular bars, placed sufficiently far apart to allow chaff and dust to pass between them, but not the grain; its cover, which extends a little above the upper ends of the beaters, is perforated with numerous holes, and above this is a set of wings, attached to a vertical shaft, that passes through the middle of the inner cylinder; the beaters are attached to the shaft by a set of arms below the lower end of the inner cylinder. The grain is fed in at, or near, the top of the machine, and enters the space between the inner and outer cylinders, and in passing to the bottom, where it is discharged, it is cleaned by the beaters, the chaff, dust, &c., being carried through the openings of the inner cylinder, and discharged at the top by an upper current, produced by the centrifugal action of the wings at the top.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the revolving frame, or beaters, with the inner and external cylinder, constructed and operating as above set forth."

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14. For an improvement in the *Revolving Cultivator;* George Whitlock, Crown Point, Essex county, New York, July 10.

The harrow teeth in this cultivator are attached to three rollers, which revolve in a triangular frame, the axes of the rollers forming a triangle. These rollers are all geared together by means of beveled cog wheels. There is a double plough at the forward end of the frame, as in the common triangular harrow, or cultivator.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the side and transverse revolving harrows, operated in the manner set forth, in combination with the frame and plough, as before described."

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15. For improvements in *Bridges;* Earl Trumbull, Little Falls, Herkimer county, New York, July 10.

This bridge, as described, is to be constructed of iron. It consists of arched truss frames, made in sections, the end of each section having a half post, and this, when united and tied to the half post of the next section, forms an entire post. These sections are farther sustained and connected together by suspension rods, which run from the upper part of one end section to the other, passing under the bottom of the middle section; and by tie rods that run from end to end along the lower line of the truss. The truss frames are connected together by transverse cast iron beams, or sills, on which the floor is laid, formed of a bottom and top plate connected together by diagonal braces, all cast together. In addition to these, the trusses are farther connected by diagonal tie rods, running from section to section, under the floor.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the suspension rods with the truss frames, made in sections, for the purpose and in the manner specified, and in combination with these, thus combined, I also claim the tie rods, as specified. I also claim the particular construction of the cast iron beams, or sills, by uniting together, in casting, the two plates, upper and lower, as described, with the diagonal bracing, as described."

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16. For an improvement in the *Wrench;* James Brett, Newburgh, Orange county, New York, July 10.

The sliding jaw, in this wrench, is provided with teeth fitting into corresponding teeth on the upper edge of the bar, and these prevent the jaw from sliding when the parts are held by a wedge which passes through a mortise in the jaw, and bears on the back edge of the bar.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the teeth on the slide, and their combination and connection with the teeth on the bar. I make no claim, whatever, as the inventor of any other part of the wrench."

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17. For an improvement in *Locks for Doors, Chests, &c.;* David Evans, Philadelphia, Pennsylvania, July 10.

"The main feature of this invention consists in the providing of a sliding plate, or cover, by which the key hole is to be closed spontaneously on withdrawing the key, and that in such manner as that the key cannot be made to enter the lock until a catch is raised, and a shaft, or handle, turned, by which the plate is made to slide back to the required distance, when the key may be readily inserted. The part by which this catch is raised, and the handle, or shaft, by the revolution of which the covering plate may be made to slide back, may be varied in numerous ways, and must, in fact, be so varied, in order to adapt the invention to the kind of lock employed, and the article to which it is appended. The sliding plate is case-hardened, where it covers the key hole, so that it cannot be drilled, or cut, by any tool."

Claim.—"What I claim therein, and desire to secure by letters patent, is the causing of a metallic plate to slide over and to close the key hole of a lock, in such manner as not to require any care on the part of the person withdrawing the key, so that a key cannot be inserted until said plate is removed; which removal is to be effected by the aid of two concurring motions, by one of which the plate is unlatched, or released, from a catch, and by the other of which it is made to slide, so as to cause a hole in said sliding plate to coincide with the key hole; the respective parts by which these effects are produced, being constructed, arranged, and operating substantially as herein set forth."

18. For improvements in *Piano Fortes;* Lemuel Gilbert, Boston, Massachusetts, July 10.

The claim is to the "constructing the centre block of the hammer with an arm projecting below its centre of motion, and having a regulating button attached thereto." To making the "jack without a regulating button, so that the fly may abut upon, or against, a long strip of cloth, or wash leather, applied to the rear of the top of the same, thereby in a high degree preventing noise in the action of the same, in combination with a hammer having its centre block constructed with the arm and regulating button." Also to a "jack having a regulating button in combination with a hammer, whose centre block is constructed as described." And finally, to "loading the centre block of the hammer."

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19. For improvements in the *Argand Burner,* for burning Camphine and other chemical oils; Stephen J. Gold, Cornwall, Litchfield county, Connecticut, July 16.

The claim is to the "mode of compressing the wick by means of two thin, movable, metallic, cylindrical tubes, combined with the wick case, the two cylinders, or wick tubes, with the wick compressed between them being inserted into the annular space between the two cylinders of the wick case, with a portion of said wick tubes extending above the wick case, to allow of their being kept cool by the draught; and also for combining with the outer cylinder of the burner and the rod supporting the button, a movable cylinder, or screw, disconnected from the rod, but having a button plate which, when the cylinder is turned up, presses against the rod and elevates it; and allows it, when turned down, to return either by its own weight, or by the action of a spring."

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20. For an improvement in the *Process of Vinous Fermentation;* Charles O. Wolpers, Cincinnati, Hamilton county, Ohio, July 16.

We are informed by the patentee, in his specification, that the "Nature of his invention consists of the method of conducting vinous fermentation in close vessels, by combining a series of close vessels with one or more open or shut vessels, as the case may require, containing a solution to be charged with carbonic acid gas."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method, or process, of conducting vinous fermentation in close vessels, by fermenting the beer, or wash, in a series of close vessels, or vats, combined and operating in the manner set forth."

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21. For an improvement in the *Tobacco Press;* Elliott Richardson, West River, Anne Arundel county, Maryland, July 16.

This patent is for an improvement in the vertical screw press, to be worked by horse power, and is a modification of that kind of press in

which the nut, through which the screw passes, turns, instead of the screw. The lower part of this nut is made with a flanch, and its upper part is poligonal, to receive and be secured to the horse sweep. The upper cross head of the press is provided with a plate of metal, through a hole in which the screw passes, and on this plate the revolving nut rests; a second plate is passed over the nut, embracing the flanch thereon, and is bolted to the head beam; in this manner the nut is held down, whilst it is left at liberty to revolve. To the head beam there is attached a cross piece, at right angles to it, from which descend two rods, or studs, one on each side of the hogshead, for the "purpose of steadying" and keeping the hogshead and the pressing screw in a vertical position.

Claim.—"I do not claim as of my invention, the actuating of the screw by the revolving of the nut. But I do claim the manner of forming and combining the nut and metallic box, as set forth, in conjunction with the combining them with the head block, by means of which arrangement the press can be conveniently worked by horse power, whilst the head block of wood is left of such strength as to render it perfectly efficient. I claim, also, in combination with the foregoing arrangement, the employment of the studs affixed in the manner described, for the purpose of steadying and keeping the hogshead and screw in a vertical position."

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22. For a combined percussion and reaction *Water Wheel;* Clark Lewis, Syracuse, New York, July 16.

This wheel is surrounded by a "stationary rim," with eight or more apertures at equal distances apart, through which the water is admitted to the wheel. The inner sheathing of the wheel is conical, and the upper and lower rims are of the same diameter, the inner edge of the upper one being united to the conical sheathing, by which an annular opening is formed at the bottom, between the lower edge of the conical sheathing and the inner edge of the lower rim, for the discharge of the water. That face of the buckets against which the water impinges when it enters the wheel, is radial, and is then curved until it reaches the lower edge of the conical sheathing, so as to form a reacting bucket.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I construct the buckets of my wheel, as set forth, so as to discharge at" (should be towards) "the centre, and produce a reaction, as well as a percussion effect, in combination with the stationary rim, having apertures in it for admitting the water to the wheel, the whole being constructed substantially in the manner, and for the purpose, above described."

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23. For improvements in the *Smut Machine* for Cleaning Wheat and other small grain; Thomas R. Bailey and Ezra Rich, the former of Weybridge, and the latter of Shoreham, Addison county, Vermont, July 16.

The patentees say:—"Our machine consists of two hollow, coni-

cal frustums, or cylinders, of cast iron, the outermost of which is stationary, whilst that within it is, when used for cleaning grain, to be made to revolve with great rapidity; each of these frustums, or cylinders, is to consist of strips, or staves, of cast iron, which are to be confined in place by means of suitable grooves, or depressions, cast on the heads, or rims, by which the ends of the staves of each frustum, or cylinder, are to be received and held together. Between each of the staves, or strips, which form the peripheries of each of the cones, or cylinders, there is to be a slot, or opening, extending along its whole length, for the passage of air."

"What we claim as constituting our invention, and desire to secure by letters patent, is the arranging of the staves which constitute the outer case, or stationary frustum, or cylinder, so that they shall overlap each other to a small distance, and at the same time leaving a space between each contiguous stave for the passage of air, smut, and other impurities from the grain, whilst the grain itself is prevented from passing through. We also claim the manner of constructing the inner revolving frustum, or cylinder, by forming the same of cast iron staves, so combined as to overlap each other, and to leave a space of a fourth of an inch, more or less, between them, for the passage of air, to be supplied from without the apartment; the whole being arranged and combined together substantially in the manner set forth."

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24. For an improvement in the *Reaction Water Wheel;* Nathaniel F. Hodges, Carning, Steuben county, New York, July 16.

"The distinguishing features of this wheel are, first, that its general form is that of a segment of a hollow sphere, each of the individual buckets, which by their combination, give to it this form, being also segments of hollow spheres; and secondly, in causing the openings between these buckets, through which the discharge of water takes place, to extend from the periphery of the wheel to the eye, or opening, through which the shaft passes. There is not, therefore, on the face of this wheel, any back, or bottom, plate, or imperforated portion upon which the water presses without having a tendency to turn the wheel." So says the inventor.

"What I claim therein, and desire to secure by letters patent, is the so constructing the wheel, as that each of its buckets shall constitute a segment of a hollow sphere, and that these shall be so arranged and combined with each as that the openings for the discharge of water shall extend from the outer rim to the eye, or shaft, and the wheel itself, thus constructed and combined, shall constitute a segment of a hollow sphere, as set forth."

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25. For improvements in the *Portable Saw Mill,* for Sawing Timber with the Circular Saw; George Page, Baltimore, Maryland, July 16.

In this mill, the shaft of the circular saw has its bearings longer than the width of the boxes in which they run, so as to allow it to

have free end play, and the saw is embraced on each side, just back of the teeth, between two friction rollers, which serve to guide it. Each of the guide rollers is attached to a separate plate, the two plates being placed one above the other, and provided with a slot for securing and setting the rollers. The carriage is made in sections for the convenience of transportation, the different sections being united by means of a rack rail at the bottom.

Claim.—"What I claim as my invention, &c., is the manner of affixing the circular saw, by allowing end play to its shaft, in combination with the means of guiding it by friction rollers embracing it near to its periphery, so as to leave its centre entirely unchecked laterally. I do not claim the use of friction rollers, embracing and guiding the edge of a circular saw, these having been previously used for that purpose, but I limit my claim to their use in combination with a saw having free lateral play at its centre. I claim the particular manner in which I have applied said friction rollers, by attaching the pins, or pivots, upon which they are sustained and revolve, to two plates of metal placed upon each other, and both held by the same set of screws, as set forth. I claim the manner of forming a long carriage from two short sections, by coupling, or uniting, said sections, by means of the rack rail only, as described."

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26. For an improvement in the *Machine for Cleansing Wool and Cotton;* William W. Calvert and Alanson Crane, Chelmsford, Middlesex county, Massachusetts, July 16.

This "improvement in the machine for separating burs, seeds, and other foreign substances, consists in our substituting for the knife, or guard, which has ordinarily been employed to arrest and separate the burs, seeds, &c., a revolving roller, which is fluted, or channeled, from end to end, or which is otherwise so formed and constructed as to cause a number of projecting edges to strike in rapid succession against the foreign matter which is to be separated from the fibres, and thus to clear, or pick, such matter out by an operation analagous to that of picking it out by the finger nail."

Claim.—"What we claim therein as our invention, and desire to secure by letters patent, is the employment of a revolving, fluted, or channeled, cylinder, or of any analogous revolving apparatus, which will present in rapid succession a number of picking, or clearing, edges, to operate upon the burs or other foreign matter contained in wool or cotton, in combination with the fine comb cylinder and the picker cylinder, or other apparatus analogous thereto, by which wool is carried up, and presented to the action of the revolving, fluted, or channeled cylinder, as described."

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27. For a method of making *Indelible Ink;* Thomas J. Spear, New Orleans, Louisiana, July 16.

The following is the whole of the specification, viz:—"Take three drachms of the least bruised India ink, and four ounces of boiling solution

of caustic soda, and mix these together, and shake the mixture well for about ten minutes, when the indelible ink is produced. What I claim as my invention and discovery, and which I desire to secure by letters patent, is the before described indelible ink."

28. For an improvement in the *Shoemakers' Paring Knife;* Isaac S. Pendergast, Barnstead, Belknap county, New Hampshire, July 16.

The patentee says:—"I do not claim to be the first to have constructed knives for paring the soles of shoes with fenders, or guides, to prevent the knife from cutting the upper leather, but what I do claim is the combining with the blade of the knife, a shield, or cap, in the manner described, viz: by forming the cap with a straight shank, flat upon one side, that it may rest upon the blade, and inserting the end of the same into the socket by the side of the blade, as described; by means of which arrangement, I am enabled to give greater strength to the blade, and at the same time protect the upper leather from being injured."

29. For an improved mode of *Heating Water for Leaching Ashes;* Joseph H. Ward, Randolph, Portage county, Ohio, July 16.

We are informed by the patentee, that the "nature of his invention consists in providing a vessel, in which ley is boiled, with a cover, or lid, sufficiently tight to prevent the escape of steam, except through a tube which conducts it into the water which is to be heated, for the purpose of leaching ashes.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the leach tub and reservoir of hot water with the boiler in which the ley is evaporated, by means of a tube, or tubes, for conducting steam from the boiler to the reservoir, for heating the water in the same, the whole being constructed in the manner, and for the purpose, set forth."

30. For an improved machine for *Cutting and Gathering Flax and Hemp;* Richard M. Cooch, Lambertsville, Hunterdon county, New Jersey, July 16.

This machine is, in its general construction, like that for which a patent was granted to William Britain and John Silvers, on the 25th of November, 1838, and noticed in this Journal, vol. xxiv of the second series, page 323, to which the reader is referred for a general description of its construction; the improved machine differs essentially from the former in its being made to cut the flax, or hemp, close to the ground, instead of being a "machine for pulling flax and hemp." The flax, or hemp, is caught between a horizontal drum and a system of endless belts, there being a projecting arm, or gathering piece, which conducts it to the drum, and whilst it is held and carried forward by the drum and belts, it is cut off, close to the ground, by a

revolving knife, which is operated by the system of belts employed to catch and hold the hemp, &c.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combining of the revolving knife with the drum, the gathering piece, and the endless bands, as herein described, so as to convert the said machine from one for pulling flax and hemp, into one for cutting and delivering the same, the whole being constructed and operating substantially as set forth."

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31. For improvements in the machine for *Cutting Crackers;* Charles P. Forbes, Baltimore, Maryland, July 16.

In this machine, the dough, after being rolled, passes on to an endless belt, in the usual way, but instead of pressing the cutters down on to the belt, on which the dough is placed, the belt is pressed up against the cutters, which are arranged above it, there being a curved plate placed under the belt for this purpose. This plate, the curved surface of which is a segment of a cylinder, is hung by two cords passing over pullies, and provided with weights, to press it up against the cutters. When the dough is passed under the cutters, the attendant rolls the curved surface of the plate against the under surface of the belt, by which operation the crackers are cut.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the edge of the outside cutters project beyond the edge of the inside cutters, and have the points of the dockers on a level with the edge of the outside cutters, as herein described, so as to dock and cut the outside edge through, whilst the inner cutters do not cut sufficiently far to separate the crackers. I also claim the method, herein described, of cutting the dough, by having the cutters and dockers permanent, and pressing the upper part of the belt, or apron, on which the dough is placed, up against the cutters and dockers, by means of a curved plate attached to a lever, drawn up by weights, and guided by hand, in the manner described."

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32. For an improvement in the machine for *Cutting Sheet Tin, or other Sheet Metal, and Glass;* Andrew Tracy, Poughkeepsie, Dutchess county, New York, July 17.

This machine differs very little from other machines for the same purpose, which have been patented. The plate of metal to be operated on is held between two plates, each of which is attached to a rotating spindle, the uppermost being provided with a spring, which bears it up when not acted upon by an eccentric lever, by which it is forced down, to hold the sheet of metal. The spindle of the upper plate is provided with a lever, with which to turn it when desired; it is furnished with a pall, which catches into the teeth of a ratchet wheel attached to the spindle. In operating with this machine, either the holding plates, with the sheet metal, may be made to turn, or the shears may be carried around the holding plate, at pleasure.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is, first, attaching the upper rotary shear to a hinged piece, regulated by a thumb screw, for the purpose, and in the manner, specified. Second, attaching the stock of the shears to a lever revolving around the centre of the holding plates; and third, the combination of the lever and ratchet with the upper holding plate, for turning the metal, or glass, as herein described."

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33. For an improvement in the form of *Spikes and Nails;* William Ballard, New York city, July 17.

This improvement in spikes, or nails, consists in making offsets, or indentations, on the opposite sides of, or around, their shank, which offsets, or indentations, are to be in such form as not to cut, or tear, the wood, as is the case with those which have projecting points, or serrated edges, formed upon them, by means of a cold chisel, or by some analogous means, in the manner which has been frequently resorted to. These spikes are also provided with a secondary head below the main head, but of less size, over which the wood will close, and thus make it adhere more firmly.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the forming of spikes, or nails, with offsets, or indentations, which offsets, are without sharp, or cutting, edges, so that when driven they shall not injure the wood, but shall hold firmly, by the collapsing of the wood upon them. I also claim the forming of the secondary head, for the purpose, and in the manner, set forth."

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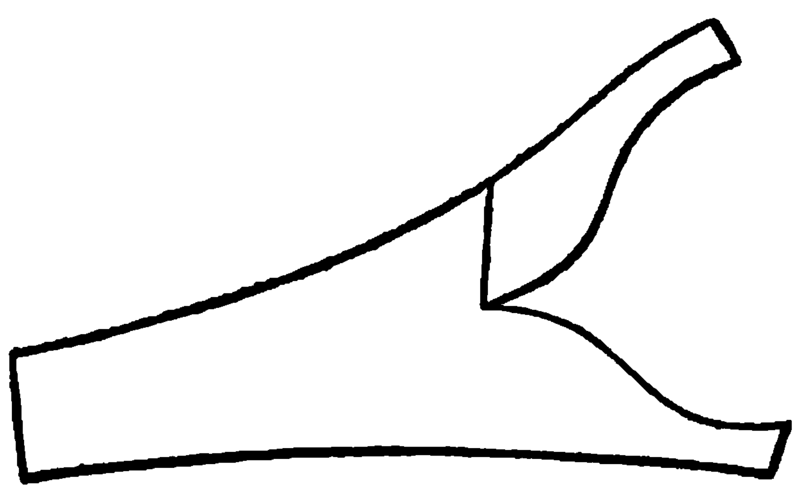
34. For an improvement in the method of *Cutting Leather for Making Horse Collars;* Thomas Parkinson, Sparta, Livingston county, New York, July 17.



Claim.—"What I claim as new, and desire to secure by letters patent, is the cutting of the leather which is to constitute the covering of the collar, to a pattern substantially in the manner of the two pieces represented in the accompanying drawing, preserving in all variations of size, the relative proportions of the respective parts, as made known."

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35. For an improvement in the machine for *Working and Pressing Butter;* Titus D. Gail, Eden, Erie county, New York, July 20.

This machine constitutes an improvement which has been added

to a patent granted on the 10th of October, 1840; the original patent is noticed in vol. ii of the third series, page 392. Instead of the permanent table, pierced with two holes, and provided with pistons working from below, and having a trough above it, as in the original machine, the table is made to slide under the trough, and is provided with several sets of holes and pistons, to receive and work the butter.

Claim.—"What I claim as constituting my improvement upon the machine originally patented by me, is the employment of the sliding table and the stationary trough, constructed and operating in the manner set forth, in lieu of the apparatus employed for the same purpose in the original machine, by which the instrument is much simplified in its construction, and rendered more convenient in use."

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36. For an improvement in the *Ring Groove Spinner;* David Hunter, Laurel Factory, Prince George county, Maryland, July 23.

In this improved spinner ring, with the hooks, or wires, through which the thread passes, and which carry it, is attached to the lower ends of the flyers, and works either in a circular concave, or between four grooved rollers, instead of working independently of flyers, as heretofore.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the construction of the ring spinner, when attached to the flyer rods, in combination with the circular concave seat, or rollers, in which it turns, as described."

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37. For improvements in the *Sofa Bedstead;* James M. Meschutt, city of New York, July 23.

This sofa is changed into a bedstead by stretching a sacking across from the upper part of the back to a rail in front, which is attached to two pieces hinged to the upper part of the two front pillars, and folding on to them, and these, when closed down, form the ornamental part, or facing, of the pillars. There is a brace hinged to the front rail, for the purpose of stretching the sacking when the frame is thrown up.

Claim.—"I am aware that a patent has been granted for a sofa bedstead, on the principle of the cot bedstead, in which a frame, hinged to the front of the sofa, is employed, and I do not therefore simply claim the employment of a frame, hinged to the front of the sofa; but what I do claim as my invention, and desire to secure by letters patent, is the adaptation of an extra frame to the front of the common sofa, connected by hinges to the tops of the pillars, and supported at the extremities by the legs, in combination with the brace which slides through the front rail when the extra frame and legs fold down against the pillars and front rail of the sofa, for the purpose, and in the manner, specified."

38. For a Compound to be used in the Cure of *Syphilis, &c.;* Silas Thurman, Lincoln, Kentucky, July 23.

The compound which is the subject of this patent is to effect the cure of syphilis, gonnerhœa, buboes, gleet, leuchorhea, &c. The recipe is as follows: "Take 12 lbs. green poke root, which is to be cut small, and boiled in 16 gallons, [water we suppose,] until reduced to half a gallon; let this cool, and press and strain it. This constitutes the first portion of the tea. For the second, take 7 oz. dry sarsaparilla, put half of this into 3 pints of whiskey, and let it remain until the strength is extracted. Then take 12 oz. cedar tops; the half portion of sarsaparilla; rattle weed, 4 oz. of the root; and half a pound of sumach, and put them into 16 galls. of water, and boil down to half a gallon. Add this to the first tea, together with the extract of sarsaparilla in whiskey, and it is fit for use. For syphilis, take 2¼ drachms of sulphur, night and morning; take epsom salts, also, to keep the bowels open, and every morning, noon, and night, take 3 oz. of the tea. Get bled every few days, until the blood becomes of a pure and natural color." "In any common case of all the above described diseases, ten or twelve days will effect a perfect cure, unless calomel has been taken, then it will require longer." "Calomel is prohibited in all cases; but in cases of syphilis, the ulcers must be greased every time after washing, with red precipitate; [ointment, probably.]

"What I claim as my discovery, and desire to secure by letters patent, is the compound formed by the above described ingredients and process; using for that purpose a smaller or greater quantity of the same ingredients, to make a smaller or greater quantity of the compound."

As may well be supposed from the general texture of the foregoing description, the original specification displays an abundant lack of knowledge upon the subject to which it refers, and we really think the application was one which ought not to have received the sanction of the seal of the patent office. The compound is analogous to such as have been frequently made, and offers no substantial novelty, whilst the effect claimed to be produced by it, will not be attained, and proceeds from entire ignorance of medical science. It is, therefore, like most patented medicines, a fraud upon the public.

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39. For an improved *Measure for Liquids;* John S. Tough, Baltimore, Maryland, July 23.

The lower part of the measure, above referred to, is to be funnel shaped, and provided with a valve, or spigot, which, when opened, permits the liquor to escape into any vessel, without the trouble of pouring out, and using a separate funnel. The instrument is divided into sections of different diameters, each diameter forming a measure of different capacity.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining with the ordinary measure for liquids, a funnel governed by a spigot, or valve, for allowing the liquid to be

let off, as set forth; and also the combining two or more of the common measures for liquids in one piece."

40. For an improvement in the *Cooking Stove*, called the "Franklin Economy Cooking Stove;" Mathew Stewart, Jr., Philadelphia, Pennsylvania, July 23.

This stove contains a reflecting oven, the form of which is that of two truncated pyramids, united at their bases, the inclined surfaces being intended to concentrate the heat in the centre. Each end of the oven is attached to a semi-cylindrical furnace, the chords of which are towards the centre of the oven. Over the furnaces there are openings for smoke pipes, and for cooking utensils.

Claim.—"No claim is made to the combination of an oven with a furnace, or heater, at each end of it; but what I do claim, and desire to secure by letters patent, is the peculiar construction of the heat reflecting oven, as described, in combination with the two semi-circular stoves, with funnel-shaped caps, for saving fuel and cooking expeditiously, as before described."

41. For an improvement in the *Mill for Manufacturing Flour;* Andrew D. Worman, Fredericktown, Maryland, July 23.

The middlings, which are to be mixed with the fresh ground chop from the burs, are put into a hopper prepared for that purpose, which hopper is so placed that the middlings contained in it shall be conducted from it into the spout, or trough, in which the elevators are carrying up the fresh ground wheat to the hopper boy; and to the hopper containing the middlings is appended a shoe and a sliding shutter, in the ordinary way, for the purpose of regulating the feed from them. In this way the middlings will be perfectly and equally distributed and mixed among the fresh ground chop, and will be, in this state, carried through the respective processes to which the flour is subjected, until it is ready to be packed.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is an improvement in the process of manufacturing flour, by conducting the middlings into the trough of the elevators, by means of a spout leading into it, and governing the feed by a hopper and shoe constructed in the usual manner, so that said middlings shall become equally and intimately mixed with the flour, and will, in the subsequent steps of the process, be entirely, or nearly so, brought into the state of superfine flour."

42. For an improvement in the *Cotton Gin;* Lewis G. Sturdevant, Delaware, Delaware county, Ohio, July 23.

In the cotton gin which is the subject of this patent, instead of the cylinder of saws ordinarily employed, there is a cylinder, the surface of which is covered with fine teeth, and over this there is another cylinder, provided with beaters, consisting of strips of iron placed

edgewise, and extending from end to end thereof. As these revolve, the beaters on the upper, are brought nearly into contact with the teeth on the lower, cylinder, the space between them being merely such as will allow the fibres of cotton to pass, whilst the seeds are beaten back, and separated from the fibres by the action of the beaters. The cotton is to be removed from the teeth by a brush cylinder, in the usual manner.

Claim.—"What I claim as new, and desire to secure by letters patent, is the separating the cotton from the seed, by the combined operation of a cylinder covered with fine teeth, formed in the manner of saw, or rasp, teeth, and of a beater cylinder, arranged and operating as herein set forth; the other parts of the gin being constructed in the usual manner, I also claim the forming of the toothed cylinder, by winding around it a cylindrical coil of wire, prepared and cut with teeth, as described."

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43. For an improvement in a Surgical Instrument called the *Speculum Ani;* Joseph T. Pitney, Auburn, Cayuga county, New York, July 23.

That portion of the patented speculum ani which is to enter the rectum, consists of two blades which are convex on their outer, and concave on their inner, surfaces; they are made tapering, or conical, diminishing in size from the handles to their outer ends. The edges of this part are carefully rounded off, and made perfectly smooth. These blades are attached to forceps handles, the two portions standing at an angle of about one hundred and twenty degrees, more or less, with each other; through one of the handles passes a set screw, by which the blades may be more gently opened, and retained in any position.

Claim.—"I hereby declare that I claim, as of my invention, the manner in which I have formed and combined the respective parts; that is to say, I claim the forming of a speculum ani with tapering, or conical, blades, united at their larger ends to forceps handles, standing at a suitable angle with the blades, to admit of the ready inspection of the parts, and furnished with a set screw to regulate the opening of the blades, by which combination and arrangements of its parts, the instrument is rendered more effective, and more convenient in use, than such as have been heretofore made for the same purpose."

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44. For an improvement in the *Mill for Granulating Corn, Powder, Bark, &c.;* Increase Wilson, New London, Connecticut, July 23.

The mill which is the subject of this patent, purports to be an improvement on the ordinary cylinder mill. It consists of two cylinders, differing in diameter, and revolving with different velocities. Angular grooves are turned around these cylinders, and upon the projecting angle of each, teeth are formed, and the toothed projections on one of the cylinders, are received within the grooves in the other.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the peculiar manner of arranging the cylinders; so as to have the cutters on each cylinder enter and run in the scores, or spaces, in the other cylinder, as described."

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45. For an improvement in the *Smut Machine*, for cleaning Grain; Samuel Bentz, Boonsboro, Washington county, Maryland, July 23.

Within a perforated cylindrical case, armed with beaters on the inside, are two sets of beaters, one within the other, which turn in opposite directions. The axes of these beaters are horizontal. The grain is fed in through an opening at the top, and passes out through an opening at the bottom; and in falling, it is met by a strong horizontal current of air from a fan, which carries off all the lighter matters leaving the grain to fall through an aperture in the lower part of the air trunk, below that in the lower part of the perforated case.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the cylinders of beaters, the one set of beaters revolving within the other set, in contrary directions, in an armed perforated cylindrical case; in combination with the fan, trunk, and gearing; arranged in the manner set forth, for separating smut, white caps, hulls, chaff, and all kinds of impurities, from the several kinds of grain which the machine is adapted to clean."

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46. For an improvement in the "*Universal Mill;*" James Bogardus, city of New York, July 29.

The mill upon which this is an improvement was patented by Mr. Bogardus on the 18th of January, 1832, and is noticed in this Journal vol x, 2nd series, page 34. By reference to this notice its general construction will be ascertained, and the subjoined claim designates the improvement.

Claim.—"What I claim as my invention, and desire to secure by letters patent, in combination with the manner of placing the upper stone, or plate, a little off the centre of the lower stone, or plate, (which I have already patented,) is, firstly, the construction and use of one or more circular grooves in either one, or in both, of the stones, or plates, as before described, or in any other manner substantially the same, to accelerate the feeding, and to produce, besides the hulling or grinding action, a cutting action like that of shears. Secondly, the combination of the upper shaft with the upper stone, or plate, in the manner hereinbefore described, or in any other manner substantially the same, to operate, in combination with other parts described, for the purposes of hulling seeds, grinding drugs, paints, dye stuffs, bread stuffs, &c.; or cutting fruits, &c."

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47. For an improvement in the form of the *Harpoon for taking Whales;* William Carsleys, New Bedford, Bristol county, Massachusetts, July 29.

The flukes, or barbs, of the harpoon above designated, are to be so

twisted as that after being thrown, it shall, on entering the body of the animal, cut its way in an oblique or spiral direction.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the twisted form of the barbs, or flukes, of the harpoon."

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48. For an improvement in *Self-setting Saw Mill Dogs;* Linus Yale, Newport, Herkimer county, New York, July 29.

The bale of the improved dog is jointed to the upper part of a sliding nut, which is made in two parts, an upper and a lower plate, bolted together. These two plates at their junction embrace two ways on which they slide. The screw that passes through this nut has on its outer end, beyond the end of the head block, a ratchet wheel permanently attached to it, and outside of this a hand lever, with a hand to catch into the notches of the ratchet wheel, for the purpose of turning the screw to set the log; and outside of the said hand lever, and turning freely on the stem of the screw, is an elbow-lever, one arm of which, by means of a pin projecting from its side, acts upon the hand lever, and thus upon the screw and dog, and the other strikes against a pin attached to the floor, as the carriage reaches the end of its course, by which the whole is put in motion, and the log set for the next cut.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is not the principle of the screw, hand lever, notched wheel, or iron band, as others of a different form have been used; but what I do claim is, first, the nut in combination with the wrought iron dog, as herein described. Second, the self-setting lever in combination with the hand lever, notched wheel, and screw, for the purpose, and in the manner, specified."

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49. For a method of making *Knobs for Doors, Locks, &c.;* John G. Hotchkiss, John A. Davenport and John W. Quincy, city of New York, July 29.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manufacturing of knobs of potters' clay, or any kind of clay used in pottery, and shaped and finished by moulding, turning, burning, and glazing; and also of porcelain."

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50. For an improvement in the machine for *Cutting Screws on the Rails of Bedsteads;* Joel Thompson, Cynthiana, Harrison county, Kentucky, July 29.

The machine above named is a modification of one in general use, for cutting the screws on the ends of bedstead rails, and consists of a stock attached to a standard, which has the usual V cutters for cutting the threads; and forward of this there is a guide, consisting of an aperture of sufficient size to receive the body of the rail, so as to insure the cutting of the threads concentric with the body of the rail. In the stock there is a gauge, which fits into a mortise in said stock,

and is joined to it, and against this, when dropped down the shoulder of the rail bears before the stock screw, by which the rail is turned, is attached to the rail, so as to insure the cutting of the screw on each end of the rail to the same point. There are two guide apertures, and an equal number of cutters and gauges, one set for a right, and the other for a left, hand screw.

Claim.—"The invention claimed, and desired to be secured by letters patent, consists in the arrangement of the stock in combination with the guide apertures, made of sufficient capacity to receive the body of the rail, and the gauges in said stock in the standard, for determining the true position of the rail in cutting the right and left screws thereon, as set forth."

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51. For an improvement in the *Manufacture of Buttons;* Thomas Prosser, Paterson, Passaic county, New Jersey, July 29—anti-dated January 29, 1841.

The buttons which are the subject of this patent are to be formed of clay, or other earthy materials, and metallic oxides, such as are now commonly used by potters in domestic earthenware; they are to be made in metallic moulds, in which the materials are compressed with considerable force.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manufacture above mentioned, consisting of buttons formed of compressed clay, or other earth materials, as set forth."

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52. For an improvement in the mode of *Combining Levers and Springs, to sustain the bodies of Wagons and other Carriages;* Elihu Ring, Trumansburg, Tompkins county, New York, July 29. (See Specification.)

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53. For an improvement in the manner of constructing and applying the Springs used as *Bumpers and Draught Springs,* in Railroad Cars, &c.; Fowler M. Ray, Cattskill, Greene county, New York, July 29.

The improved springs consist of flat and straight leaves, or plates, of spring steel, there being two or more leaves, either of equal or of unequal length, and so placed as to stand across the frame of the car, from side to side, where they are received in pockets, the sides of which, towards the springs, are so curved as that under an increased pressure the points of bearing are gradually approaching, and thus increasing the rigidity of the spring.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining of springs composed of straight leaves, or plates, of steel, in the manner set forth, with pockets curved at their sides, in such a manner as that the flexure of said springs shall cause them to diminish, progressively, in their effective length, and consequently to increase in their power of resistance. I claim, in combination with said springs and pockets, so constructed and arranged, the employ-

ment of the curved check pieces, to co-operate with the curved pockets when the leaves are all of one length. I claim, also, the substitution for said check pieces, and the combining with the long leaves, which extend to the bottom of the pockets, such number of shorter leaves as may be found necessary, and in the manner herein described."

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54. For an improvement in the *Portable Saw Mill;* James C. Mayo, Columbia, Fluvanna county, Virginia, July 29.

In this improved mill the log is stationary, and the frame in which the saw works moves up thereto, it being made to slide forward for that purpose. A rack attached to the movable frame passes over a pinion on the axle of a ratchet wheel, giving motion to it in the same manner that the carriage of the common mill is actuated. The saw, instead of being strained in a saw frame, is attached at its upper end to a block which slides in ways, and at its lower, to a crank which is actuated by a belt that passes around a drum on the shaft of the crank, and also around a drum at each end of the frame.

Claim.—"What I claim as new, and desire to secure by letters patent, is the particular combination and arrangement of the respective parts thereof, as set forth—that is to say, I claim the described manner of combining the saw with the sliding frame; the crank to which the lower end of the saw is attached having its bearings in said sliding frame, and the sliding frame being made to embrace the side pieces, and being otherwise combined, and arranged, and actuated, in the manner set forth. I am aware that a saw has been actuated directly by a crank at its lower end, and that a saw has also been made to move up towards the log by means of a sliding frame; but these have not been used in combination with each other, and I therefore limit my claim to this combination, under the arrangements substantially as above described."

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55. For improvement in *Fire Arms;* Charles Lewis Stanislas Baron Heurteloup, a subject of the King of the French, July 29.

The fire arms which are the subject of this patent are of the percussion kind. The compound employed for priming is contained in a small flattened lead tube; this priming tube is placed within a covered channel made in the under side of the stock, and from this it passes into a channel made in the lock plate, which is, for that purpose, made longer than usual, and attached to the under side of the stock. This plate has a large chamber made in it, in which the explosion of the priming, &c., takes place. The continuous priming is carried forward, at every re-loading, by a cog wheel, which is turned by the thumb, the priming being pressed up against the cogs by a flat spring. At each discharge, a piece of this priming is cut off, by a cutter attached to the cock, is carried to the touch hole, and is there exploded, by the hammer.

Claim.—"What I claim, and desire to secure by letters patent, is, first the making of the large plate so as to adapt it to the reception of the mechanism which moves the continuous priming, also making therein

the chamber to receive the smoke, or deposit, caused by the ignited powder, in order that it shall not injure the different parts of the lock, which large plate also presents the peculiar characteristics of containing within itself the hole to receive the axis of the cock, the receptacle, or channel, for the priming, the chamber to receive the smoke, and the spitter, all within the same solid piece of metal, so that the distances between the various parts of the machinery herein described, being always fixed and invariable, the action of the parts shall not admit of any variation; all as described. Secondly, the making of a covered channel, for confining the continuous priming between the barrel and the stock, in the stock before the lock, from which it can be drawn towards the touch-hole; and in combination therewith, the priming conducting spring, which presses the priming towards the wheel; the wheel for moving it forward, or backward, and fixing it, all as hereinbefore described. Thirdly, the compressor with two shields which is fastened to the lock, in the mode, and for the purpose, specified."

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56. For an improvement in the mode of *Propelling Ships, Boats, and other Vessels;* Elisha F. Aldrich, city of New York, July 30.

In this improved mode of propelling boats, &c., the wheels are constructed with permanent radial paddles, the ends of which but against the rims of the wheels, so that the principal part of the water against which the paddles act has to pass in between them, through the space between the inner periphery of the rims and the centre, or hub, and is forced out by centrifugal power against the water back of the wheel—thus impelling the boat forward. The wheels constructed in this manner are placed either in hollow trunks, or cases, within the vessel, or in similar cases built outside, and open at the bottom, the wheels projecting below the bottom of the trunks, or cases—or they may, it is said, be placed horizontally, and act on the water at the sides of the vessel.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of propelling ships, boats, and other vessels, by means of wheels that receive water at the centre, or any distance from the centre, and throw it out at the periphery by the action of the centrifugal force, as herein described. I also claim the mode described and set forth of constructing wheels to be applied to vessels for the propulsion of the same, the wheels to revolve vertically or horizontally; and I claim, also, the mode of placing the wheels nearly, or quite, as low as the bottom of the vessel, to revolve within cases attached to the sides of the same, as described."

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57. For an improvement in the machine for *Planting Cotton Seed;* R. S. Thomas, Bennetsville, Marlborough District, South Carolina, July 30.

The bed piece of this machine rests on the ground, and is provided with a piece like a keel forward of the seeding roller, for making the furrow; that portion of the bed piece which is back of the seeding roller

is hinged to the forward part, so as to yield in passing over stones, &c. The seeding roller is made with ridges, or points, between the excavations for the seeds, for the purpose of agitating them to insure their falling into the excavations. This roller is carried round by two wheels on its axle, which run on the ground. The hopper rests freely on the seeding roller, that part of its surface which rests on said roller being covered with leather, or other yielding substance.

Claim.—"What I claim as new and desire to secure by letters patent, is the manner of constructing the seeding roller with alternate ridges, or points, and excavations for the reception of the seed to be planted; the ridges, or points, operating as agitators to keep the seed in motion, and cause it to fall into the excavations. I am aware that agitators have been frequently used within a hopper in seeding machines, but these have been constructed in a manner much more complex than that employed by me, which method is perfectly effective and simple, not requiring any additional moving parts. I claim the manner of forming the bed piece in two parts, the rear part being hinged to the forward portion in the manner described, and for the purpose of covering the seed that has been planted, and this I claim in combination with the ridge, or keel piece, for forming and preparing the furrow, said keel piece extending along the bottom of the bed piece. I also claim the forming the bearing of the hopper upon the planting, or seeding roller, by means of a piece of leather, or other elastic material, in the manner set forth."

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58. For an improved manner of constructing the *Grates of Kilns*, used for burning lime for the manufacture of Potash, or of Salt; William B. Hill, Bellevue, Eaton county, Michigan, July 30.

Claim.—"What I claim as new and desire to secure by letters patent, is the forming the combined bars, or fire supports, arranged as described, in part of metal, and in part of fire-proof, earthy compound, substantially in the manner, and for the purpose, described; and the combining of said compound fire supports with each other by means of a suitable frame, and of a rod, or bar, to which the swinging edges of each of them is jointed, for the purpose of opening or closing them in any required degree, by which means the draught may be regulated, and ashes, or other matter, may be readily discharged."

Specifications of American Patents.

Specification of a Patent granted to Elihu Ring, *of Trumansburg, Tompkins county, state of New York, for Graduating Springs for Carriages. Granted July* 29, 1841.

To all whom it may concern: be it known that I, Elihu Ring, of Trumansburg, in the county of Tompkins, and state of New York, have invented a new and improved mode of combining springs and levers, and of applying them so as to sustain the body of a wagon,

or other kind of carriage, and its load, in an advantageous manner, they being, by their peculiar construction, capable of being adapted to the amount of the load which they are intended to sustain; and I do hereby declare that the following is a full and exact description thereof:

These combined springs and levers may be arranged in various ways without changing the nature of their combination and action, which combination and action are clearly exemplified in the following drawing. In this, A, A, are the timbers upon which the wagon body is to rest, and which are framed together by means of the longitudinal timbers, B, B, which may be denominated the upper spring bars. The pieces C, C, sustain the axles, and are connected together by the longitudinal piece, or perch, D, D. Between the pieces A and C are the elliptic springs, E, E, which are of the ordinary kind, and are affixed in the usual manner. When the load is light, it is principally sustained by these springs. Instead of elliptic springs, others of any of the known kinds adapted to the purpose, may be used. F and G constitute a connected lever and spring, which are so combined as to be readily adjusted, so as to exert a greater or less degree of force, as may be desired.

The spring G rests against a fulcrum piece, or block, H; is connected at its outer end to the lever F, by means of the spring I, working on a joint pin. At its inner end the spring G may be drawn up by means of a screw nut and bolt, J. The lever F bears by its outer end upon a friction roller, K—its fulcrum being the bolt L, which passes through the timbers, B, B. The spring G is necessarily made very stout, as it is intended to act under the pressure of very heavy loads. A similar lever and spring are seen in the drawing, as acting on the opposite side of the frame; and this resembles that above described, in every particular, but stands in a reversed direction.

It will be seen, that by this arrangement of the springs and levers the whole action may be thrown upon the elliptic springs; that the levers and springs may be lightly strained together, so as to bear their portion of the load when it is increased somewhat beyond that to which the elliptic springs are adapted; or that they may be brought to a high degree of tension whenever the nature of the load renders

it desirable that this should be done. The upper and lower portions of the frame may advance and recede with perfect freedom, the outer ends of the levers, F, playing backward and forward upon the friction rollers, the spring G acting unobstructedly by the play of its end upon the jointed stirrup.

Having thus fully described the manner in which I combine and arrange the respective parts of the apparatus used by me, what I claim therein, and desire to secure by letters patent, is the combining with the elliptic, or other springs, occupying the situation in which they are represented—the combined levers and springs, F and G, being so connected and arranged as to operate substantially in the manner herein set forth.

These springs and levers may be increased in number; they may be placed in an inverted position, and changed in form, without materially changing their nature and action; and I do not, therefore, intend to limit myself in these particulars, but to introduce any variations which I may think proper, whilst the same result is attained by means substantially the same.

ELIHU KING.

Practical & Theoretical Mechanics & Chemistry.

MR. MALLET'S *Processes for the Protection of Iron from Oxidation and Corrosion, and for the prevention of the Fouling of Ships.*

The discovery of an effectual means of protecting iron, copper, and other metallic surfaces, from the injurious effects of exposure to atmospheric and aqueous influences, had long been an object of earnest, but nearly unavailing pursuit, as well among men of science as among mere practicians, when the successful application of iron to the building of ships gave suddenly a new impetus and great increase of importance to the inquiry. Sir Humphrey Davy had found out how to save copper sheathing from corrosion, by means of zinc protectors; but subsequent experience showed that, in proportion as the copper was thus electro-chemically preserved, it was rendered more liable to be *fouled* by the adhesion of animal and vegetable substances—an evil scarcely inferior in magnitude to that of the destruction of the copper itself; and farther than the point so reached by Davy, science had not advanced, when the first iron ship was launched into the deep. Much was at one time said of certain patented processes of zincing, by which it was alleged iron could be so thoroughly coated, as not to leave a speck unexposed for air or water to act upon—and much was hoped from them; but one after another they all proved decided failures. In the best zinced sheets of iron produced by these processes, there were always found a number of spots which had been left bare, by the collection of rust on which, the protective power of the zinc, in respect to the remainder of the iron, was almost entirely neutralized. Of "anti-corrosive" and "anti-barnacle" paints and varnishes there had been also an abundance, both before and since the

days of Davy, but not one which could be said to have survived the test of practice, or which was not, more or less, of an empirical character.

So matters stood—that is to say, about the time of iron first coming into extensive use for the construction of ships—when the British Association were induced to take up the question, as one of the most practically important of the day, and to devote a portion of their funds to the institution of a series of experiments in relation to it, under the direction of Mr. Robert Mallet, of Dublin, a gentleman eminently fitted, by practical habits and experience, as well as by scientific knowledge, to do justice to the task intrusted to him. The details and results of these experiments are related in two reports made by Mr. Mallet to the Association, and published in their Transactions: and though they go little farther than to show the defects of existing processes, (that of zincing more particularly,) they must be allowed to have accomplished a most valuable service, in having cleared the subject from the vast mass of false science and erroneous practice by which it had become encumbered.

Mr. Mallet, following out the course of investigation thus auspiciously commenced, has since happily mastered all the difficulties of the case, and devised a series of remedial processes with so much of science, and therefore of sufficient reason, in them, as to leave no doubt on our minds of their perfect efficiency. To indicate briefly Mr. Mallet's discoveries, they may be said to consist, *first*, in a method of zincing iron so perfectly, that not a spot of the iron is, or can be, left unprotected; *second*, in a method of protecting iron and other metals by means of palladium, (at a moderate cost,) which renders them as incorrodible by air and moisture as palladium itself (*palladiumizing*, it may be called, with as much propriety as we say, *zincing*, or *gilding*, or *soldering;*) and, *third*, in a new paint, to which, from its life-destroying properties, Mr. Mallet has given the name of *zoofagous* paint, by the application of which to vessels, whether of wood or iron, or with whatever material they may be sheathed, *fouling* is rendered impossible. The following details of these processes, which we have great pleasure in being the first to lay before the public, we extract from Mr. Mallet's specification, which has been just enrolled.*

1. *The Zincing Process.*

Supposing the articles about to be zinced, are plates and ribs of iron, intended to be employed in the construction of an iron vessel, they are first carefully cleaned from all adhering oxide. With this view they are immersed edgewise in a suitable vessel of wood, pottery, stone, or lead, containing dilute sulphuric acid of the specific gravity of about 1.300 at 60° of temperature, or dilute hydrochloric acid of the specific gravity of about 1.060 at 60° of temperature, formed by diluting these acids respectively as they are usually found in commerce with rather more than an equal bulk of water. As it is of importance that the scales of oxide should be detached as rapidly as

* Enrolment Office, January 7, 1842.

possible, the diluted acid should be warmed; and this may be conveniently effected by means of a steam jacket round the vessel, or by blowing steam into the acid; the acid vessel, or "Cleansing Bath," as it may be termed, should be so constructed for operations on a great scale, that the lower portion of the acid, and the scales which are precipitated, can be occasionally withdrawn to prevent waste of acid, or the cleansing process from being inconveniently protracted. The iron must be wholly, not partially, immersed, and the bubbles of gas formed on its surface must be free to ascend in the fluid and escape. As soon as the scales of oxide have become detached, or loosened, the articles are to be removed from the "cleansing bath," thrown into or washed with cold water, and struck or hammered to shake off and detach the scales. In the case of flat boiler plates, they may be advantageously passed backwards and forwards, through the machine known to boiler makers as "a mangle." The surfaces of the iron are then to be thoroughly scoured, by hand or by any suitable machinery with sand or emery, or with pieces of grit stone, while exposed to a small running stream of water, until they appear quite clean and of a bright metallic lustre. The articles are now, before being allowed to dry, to be plunged into a "preparing bath," consisting of the following mixture: A saturated cold solution of chloride of zinc is made by dissolving zinc or its oxide in hydrochloric acid; to this is added an equal bulk of a saturated cold solution of sal ammoniac; and to the mixed solutions as much more sal ammoniac in the solid state is added, as they will dissolve. Or, these solutions may be made and mixed hot, and the solid sal ammoniac then added, but the addition of some cold water will then be requisite to dissolve the whole of the salts so formed. The bath may also be formed of sulphate of zinc and sulphate of ammonia, or acetate of zinc and acetate of ammonia, or of any other soluble salt of zinc and ammonia or salt of manganese and ammonia. The nitrates of zinc and ammonia are the least advantageous, and it is stated that none answer the purpose so well as the chloride of zinc and sal ammoniac first before directed to be used. No free acid should be present in these solutions. As soon as the surfaces of the immersed articles appear covered all over with minute bubbles of gas they are then in a fit state for combining with the metallic alloy with which they are next directed to be coated; but they may be allowed to remain in the preparing bath for any convenient length of time without injury or prejudice to the subsequent processes. The metallic alloy last referred to is prepared in the following manner: A quantity of zinc is melted in a suitable vessel (one formed of pottery or stone is found to answer best,) and when it is in a state of fusion, mercury or quicksilver is added, in the proportion of 202 parts of mercury to 1292 parts of zinc (both by weight) being in the proportion of one atom of mercury to forty atoms of zinc, both upon the hydrogen scale. The two metals are well stirred or mixed together with a rod of dry wood or of iron coated with clay; and when this has been done there is added one or the other of the metals know to chemists and others as potassium and sodium (the métallic bases, of which the well known alkalies potash and soda, are oxides) in the proportion of a

pound or thereabouts of potassium or sodium to every ton weight of the alloy of zinc and mercury, or in some cases less will suffice; either potassium or sodium will answer the purpose, but Mr. Mallet prefers the latter, as more easily obtained and more manageable. Whether it is potassium or sodium which is used, it is removed from the naphtha, or other fluid in which it is customary to keep these metals in order to preserve them from oxidation, in small portions of not more than half an ounce at a time, and by means of a small inverted cup of wood, formed on the end of a stick, thrust rapidly below the surface of the alloy of zinc and mercury, so as to avoid any waste or combustion of the alkaline metal. A triple alloy is thus formed of zinc, mercury, and sodium or potassium, which having been again stirred and mixed with the rod of dry wood, or of iron coated with clay, is now ready for covering or coating the prepared iron. The combination of these metals is facilitated, and their oxidation on the surface retarded, by pouring upon their fluid surface some of the liquor of the preparing bath, or strewing upon it some of the salts dissolved in that liquor in a dry state.

The plates or ribs of iron are now to be taken up out of the preparing bath, permitted to drain for a few seconds, and while still wet with the liquor of the preparing bath, immersed in the triple alloy in a state of fusion. As soon as they have acquired the temperature of the bath of alloy, they are to be withdrawn from the metallic bath edgewise or endwise, when they will be found covered with a perfectly uniform and coherent coat or surface of the alloy. The affinity of this alloy for iron is, however, so intense, and the peculiar circumstances of surface as induced upon the iron presented to it by the preparing bath are such, that care is requisite lest by too long an immersion the plates are not partially or wholly dissolved. Indeed where the articles to be covered are small, or their parts minute, such as wire or nails or small chain, it is necessary before immersing them to permit the triple alloy to dissolve or combine with some wrought iron, in order that its affinity for iron may be partially satisfied and thus diminished. At the proper fusing temperature of this alloy, which is about 680° Fahr. it will dissolve a plate of wrought iron of an eighth of an inch thick in a few seconds. No spluttering is produced by the immersion of the iron wet from the preparing bath into the alloy; but care is to be taken that there are no hollow places or cavities in the articles immersed which the alloy cannot wholly fill; lest in such case steam may be generated below the surface of the metal, and a dangerous explosion be thereby occasioned. It is stated to be desirable that the melting vessels should be as deep and expose as small a surface as the nature of the articles to be immersed will allow. At the moment of immersion of the articles, the surface of the alloy is to be cleansed of all dross or oxide by a wooden skimmer. As soon as the iron plates or ribs are withdrawn from the alloy or "Metallic Bath," they are to be plunged into cold water and well washed therein. The surface of the iron is now in a condition permanently to resist corrosion and oxidation in air, or in salt or fresh water.

All the foregoing operations are best performed upon the plates or

ribs after they have been bent and fitted to their places, and the plates have been riveted together into large pieces of eight to ten feet square or more. When again put "into frame," or placed in their respective positions in the ship's hull, they are directed to be united by rivets countersunk from the outside, and consequently headed inside the vessel. The countersunk heads of these rivets are to be also coated with the triple alloy in the manner before described, and tongs of iron are to be provided, having a very large mass of metal in their jaws, between which a hollow seat, of the shape and size of the countersunk rivet head, is to be formed to receive it. An alloyed rivet being seized by a pair of such tongs may have its point heated to a riveting or welding heat without injuring the coat of alloy upon its countersunk head; for the heat is carried off from the latter so fast by the contact of the large mass of iron in the jaws of the tongs, which are to be cooled occasionally, as to prevent the head of the rivet becoming hot during the heating of the point in a common smith's fire.

The hull of the iron vessel, being thus completed, and wholly covered with the alloy, is then to receive a coat of varnish all over, of either of the compositions about to be described. If possible, this varnish should be laid on with a spatula or thin flexible blade of horn, or some such material, as a brush produces minute air bubbles, which leaves spaces uncovered on the drying of the varnish. The varnish will dry, or get hard and coherent, at ordinary temperatures; but when practicable, it is desirable to expose it for some hours to a temperature of about 300° Fahrenheit, which gives it greater adhesion and durability. The iron surfaces may be warmed in successive portions by heat radiated from "chauffers" or open fires of coke, or by any other convenient means. The varnish may be either of a composition, which Mr. Mallet terms No. 1, or of another, which he terms No. 2. The composition No. 1, is formed as follows:—Take 50 lbs. of foreign asphaltum, melt and boil it in an iron vessel, for three or four hours; add gradually 16 lbs. of red lead and litharge ground together to a fine powder in equal proportions, with 10 imperial gallons of drying linseed oil, and bring all nearly to a boiling temperature. Melt in a separate vessel eight pounds of gum anime (which need not be of the clearest or best quality;) add to it two imperial gallons of drying linseed oil, boiling, and twelve pounds of caoutchouc softened, or partially dissolved by coal tar naphtha (as practised by the makers of water-proof cloths.) Mix the whole together in the former vessel, and boil gently until, on taking some of the varnish between two spatulas, it is found tough and ropy. When this "body" is quite cold it may be thinned down, with from 30 to 35 gallons imperial of turpentine, or of coal naphtha, which will make it ready for use. Mr. Mallet states this to be the best varnish he is acquainted with for this purpose. It is not acted on when dry and hard, by any moderately diluted acid or caustic alkali; it does not by long immersion combine with water, and so form a white, and partially soluble hydrate, as all merely resinous varnishes and all oil paints do; it is, moreover, so elastic, that a plate covered with it may be bent for several times without its peeling off. And, lastly, it adheres so fast, that nothing

but a sharp edged instrument will scratch it off the surface of iron. The composition No. 2 is of a cheaper sort, but not quite so good. Common coal or gas tar is to be boiled in an iron caldron, at so high a temperature, that the smoke from it is of a yellow dun colour; or the tar is to be caused to flow through red-hot iron tubes. The boiling passage through the tubes is to be continued until the residue is a solid asphaltum, breaking with a pitchy fracture. It is essential that the boiling should be carried on at this high temperature, as the permanence of the varnish in water depends upon the tar having been submitted to the temperature at which naphthaline is formed, by the decomposition or breaking up of the original constitution of the tar. Take 56 lbs. of this coal tar asphaltum; melt it in an iron vessel: add ten imperial gallons of drying linseed oil, ground with twenty-five pounds of red lead and litharge, in equal proportions; add to the whole, when well mixed, and after boiling together for two or three hours, fifteen pounds of caoutchouc, softened or partially dissolved by coal naphtha, as before described; and when cold, mix with from twenty to thirty gallons of turpentine, or coal naphtha, which will make the varnish ready for use.

[TO BE CONTINUED.]

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Fabrication of Gas for lighting from Soap-suds employed in cleansing stuffs. By M. HOUZEAU MUIRON.

A few years ago the immense quantity of soap-suds employed in the city of Rheims in preparing woollen stuffs was entirely lost. M. Houzeau Muiron conceived the idea of extracting from them the fatty matter, and of making an important application thereof. In fact, by submitting them to a regular purification, he has obtained a limpid oil, with which he succeeds in preparing the soaps in demand in commerce, while the residue of this purifaction serves for the advantageous production of a gas for lighting a part of the city.

The soap-suds collected in the shops, where they have become saturated with grease and the impurities of the tissues, are poured together into a large basin which is capable of containing about 3,000 gallons. To decompose them, there is poured upon them 308 pounds of muriatic acid, or 154 pounds of sulphuric acid, first diluted with its own weight of water, and the mass is rapidly agitated until the decomposition is complete.

Shortly afterwards a froth is seen to form, which at the end of twelve or eighteen hours is sufficiently well separated from the water upon which it floats. Four-fifths of this water is then run off, containing about one per cent. of sulphate of potassa which is utilized either by evaporating it in drying-houses, or by running it off upon dry earth exposed to the air, which when sufficiently charged with the salt is washed. Directly after this operation, the basin is filled again with a fresh portion of soap-suds, which float the fatty matter and permit it to be run off into a side tub. The product obtained is a

mixture of unaltered oil, the acids, animal matters and a large quantity of water which forms with them a species of hydrate. This water is disengaged by injecting several times into the mass a current of steam which heats it and facilitates its evaporation. The fatty matter is then run off into a boiler where it is submitted to a rapid ebullition, aided by continual agitation, which drives off the last portions of water. The product contains twenty or twenty-five per cent. of impure matters which colour it and render it turbid. To purify it, it is poured into basins of copper and mixed with two per cent. of concentrated sulphuric acid. After two days the limpid oil comes to the surface, while the impurities are precipitated to the bottom.

The oil is carefully separated, and the deposit, when filtered through cloths in a press, gives still a large quantity of oily products, which are added to the preceding and made into soap by treating them with common soda.

The residuum is black and very thick; from it M. Howzeau produces the gas for lighting, but before introducing it into the retort, he liquifies it by means of the empyreumatic oil obtained in the preceding operation.

The gas thus prepared is purified by lime, and the water from the washing contains sufficient cyanide of calcium for the preparation of Prussian blue from it, by treating it with sulphate of iron and washing the precipitate with muriatic acid.

This gas possesses a considerable lighting power, and in order to apply it to the lighting of the establishments scattered throughout the city of Rheims, M. Houzeau has contrived a manner of transporting it, at the same time simple, economical and free from danger.

F. Boudet.

Jour. de Pharm. et de Chim., May, 1842.

Robert Stephenson's *New Locomotive.*

With the progress of the locomotive engine, it has, like other machines of extensive use, attained that period when its economy becomes of the greatest importance. Influenced by such considerations, Mr. Robert Stephenson has directed his attention to a less consumption of fuel, and to effecting a more simple arrangement of the machinery, both of which points have been well managed in his new engine now running on the York and North Midland Railway.

Economy in the consumption of fuel has been obtained, by adding considerably to the length of the tubes, without increasing the distance between the front and back axle of the engine; consequently the space occupied by the engine upon the bearing is precisely the same, therefore no alterations are requisite in the turn-plates, or other arrangements made for the accommodation of the ordinary locomotives. The machinery is simplified by placing the axles of all the wheels under the cylindrical portion of the boiler, the axle of the front wheels being placed close to the smoke box, and the axles of the hind wheels close to the foremost end of the fire box, instead of the back part. This arrangement allows the axle of the driving wheels to be placed in the

centre of the other two axles, or at such intermediate distance as may be found the most suitable for the moving parts.

The alteration in the construction of the boiler and tubing gives a heating surface of 800 superficial feet, whereas in the ordinary engine it rarely exceeds 450 feet, being for the new plan a superiority of fully 350 feet. Such is the effect produced by this addition, that the temperature of the air escaping in the chimney scarcely exceeds the temperature of the water in the boiler; a circumstance which has a farther beneficial effect beyond the economy of fuel, for it has been found, by increasing the extent of heating surface, and employing usefully the whole of the heat generated in the fire, that a less violent draught of air is required; the consequence is that very few hot ashes are thrown out of the chimney; this peculiarity is quite remarkable in the engine now running. A few days since, a journey of ninety miles was performed by this engine, during which no ashes were thrown out of the top of the chimney, and at the same time the accumulation in the smoke box was very trifling, not exceeding a fourth of the usual quantity. As the tendency to eject ashes from the chimney is dependent upon the speed, it is necessary to state, that the speed was never below twenty miles per hour, generally exceeded thirty, and for several miles a speed of forty-eight miles per hour was uniformly attained, with five loaded coaches.

The consumption of fuel during the above experiment was 19.2 lb. per mile, with a load of eight coaches over half the distance (forty-five miles,) and five coaches over the remaining half. This consumption includes the whole of the fuel used in lighting the fire and raising the steam.

We may truly say, that we have never witnessed an instance where speed and economy were combined to the same extent; indeed, under no circumstances have we heard of the consumption of fuel being reduced to so low a figure. It must, however, be borne in mind, that this result is from a single experiment, and that we must not be deluded by isolated trials; but we are glad to hear that on the line where the engine is now working, the Company have ordered an accurate record of the performance, and quantity of fuel consumed during each trip, which we hope will be made public.

Mr. Stephenson has introduced tubes of wrought iron, instead of brass or copper, in order that the increased heating surface might be obtained without a corresponding augmentation in the price of the engine. This he has not adopted without making several experiments. During the last twelve months, he has had several boilers working under his own eye with iron tubes, for the special purpose of determining how far he could recommend them for general adoption. The result has been all that he could desire; and it is owing in some degree to this, that he has introduced them with greater confidence.

Having now described the modification in the boiler, we shall proceed to point out Mr. Stephenson's alterations in the mechanical arrangement. In the ordinary engines, the mechanism for working the slide valves is very liable to derangement, and considerable wear and tear. This part of the engine he has so far simplified, as to require

only a simple connection between the eccentrics and slide valves, thus doing away with a considerable number of moving parts, which have hitherto given rise to more casualties than any other part of the ordinary engine. This is attained by placing the slide valves vertically on the sides of the cylinders, instead of on the top, as heretofore, so that the direction of the sliding motion of the valves, and the central line of the valve rods, will intersect the central line of the main axle, at the point where the eccentric is placed. In this case, the eccentric rods are connected immediately to the prolongation of the valve rods, without the usual intermediate levers and weigh bars; besides, the slide valves of both cylinders are placed in one steam chest, between the cylinders.

Another improvement is that effected in the working of the feed pumps: it consists in connecting the pump rods to the eccentrics used for reversing the engine. By this arrangement, the velocity of the moving part of the pump is greatly dimished, by which is secured greater regularity in action. In addition to what we have already described, there are several minor alterations, which we cannot fully explain without giving detailed and elaborate drawings.

The following are the principal dimensions of the engine now working on the York and North Midland Railway:—

Diameter of cylinder - - -	14 inches.	
Length of stroke - - - - -	20 "	
Diameter of driving wheels - -	5½ feet.	
Ditto of small ditto - - - - -	3 "	
There are 150 tubes, giving a heating surface of		765 feet
Copper fire box, with a heating surface of - -		30 "
Total heating surface		795 feet.
Length of boiler, including fire and smoke boxes		17 feet.
Weight of the engine in working order		15 tons.

Civ. Eng. & Arch. Jour., Feb. 1842.

A New Cement, a substitute for Glue and Caulking.

Amongst the numerous inventions submitted to the Lords Commissioners of the admiralty, and referred by their Lordships to the committee of master shipwrights recently sitting at Woolwich dockyard, was a composition to be used in place of the substance with which vessels are at present caulked to render them water-tight. The experiments ordered to be made by the master shipwrights to ascertain its value when applied to the purpose for which it is intended, and the result, are interesting and satisfactory. Two pieces of African teak, a species of wood difficult to be joined together by glue, on account of its oily nature, had a coating of the composition applied to them in a boiling state, and in a short time afterwards bolts and screws were attached to each end, the joined wood placed in the testing-frame, and the power of Bramah's hydraulic engine applied to the extent [illegible]een tons, when the chain broke without the slightest strain be-

ing perceptible where the jointing took place. A larger chain of one inch and a half in diameter was then applied, which broke with a strain of twenty-one tons, the joint in the wood remaining apparently as firm as at first. The utmost strain the cement can bear in this form, therefore, remains to be proved when experiments are made with larger chains. Four pieces of hard wood were then joined together, weighing in one piece forty-four hundred weight, and carried to the top of the shears in the dockyard, a height of seventy-six feet, from which it was precipitated on the hard granite wharf wall below, without any of the joints yielding in the smallest degree. The results of these severe tests induced the Lords Commissioners of the Admiralty to communicate with Lieutenant-General Sir George Murray, G.C.B. and G.C.H., for the purpose of making experiments with it in the marshes at Woolwich, by bringing the full force of cannon balls against it. Accordingly, a number of planks of oak eight inches thick and fir sixteen inches square, were joined together with the cement, to together eight feet in height and eight feet in length of the side of a first rate ship of war, without any thing else in the shape of bolt or security to assist the composition; and it was set up as a target at the butt in the marshes; when a number of officers of the Royal Artillery were present to witness the experiment. Three shots were first fired, every one entering the target, the third in a direct line with the bull's-eye within three inches of its outer circle. The effect of these shots were wonderful, they tore the wood to pieces, and excepting in one instance, where the joint had not been good, they had no effect upon the cement. A hole six inches and a quarter in diameter was then bored in the centre of the target, and a thirty-two pounder shell inserted and exploded by a match, which tore the wood to small splinters without in many places in the least separating the composition. This new invention is said to possess the power of expanding like Indian rubber in warm climates, and will not become brittle under the coldest temperature. It appears to be a great favourite with naval officers, as it is so clean, having only the appearance of French polish. The name of the inventor is Mr. Jeffrey.

The substances of which *the cement is composed* are simple, being merely *shell-lac and Indian rubber dissolved in naphtha* in certain proportions; and being insoluble in water, the purposes to which it may be applied are numerous. Its value is about half the expense of common glue, the saving to the country by its universal adoption will be incalculable, as the inventor has been employed in experiments with it for upwards of two years, and has found that in the absence of great friction it is in a manner imperishable. An experiment was tried in the dockyard, which shows the value a supply of the cement will be of to vessels which may be damaged at sea. Eight pieces of wood were joined together in the form of a mast, and a strain applied to them and to another mast of one piece of wood. The latter gave way first, and the other only broke after being considerably bent and the application of a rather great strain. By this substance, therefore, it is certain that ship carpenters can have no difficulty in effecting repairs at sea, which could not be done under any other circumstances.

Ibid., June, 1842.

Dreadful explosion of a Steamer and Melancholy Loss of Life.

Our readers are aware that a fine fast-sailing steamer named the *Telegraph*, was lately built for the river trade, for the purpose of competing with the railway. She has been plying for some time back, and being on the high pressure principle, has beaten the swiftest steamers in the passage to Greenock. To-day, about half-past 12, the people on the steamboat quay, Greenock, heard a report as if a battery of cannon had been discharged at Helensburgh, (a distance of four miles.) A smoke was seen to arise, and telescopes being procured, the explosion of the *Telegraph* was immediately discovered. Two of the tug steamers lying at Greenock quay got their steam up, and sailed for Helensburgh, to render whatever assistance they could. On arriving at Helensburgh they found that the *Telegraph's* boiler had exploded, and that the hull of the vessel was a total wreck, and literally floating away in pieces. At the time our informant left, it had been ascertained that thirteen had been killed outright, but as strangers were on board, it was impossible to arrive at a true statement of the casualties. A number of persons were seriously wounded, some of whom are not expected to recover, and among the latter we are sorry to say is Captain Ewing, late of the Kilmun steamer, who was just alive when our despatches were sent off. It appears that the passengers for Helensburgh had all landed, and that the boat was about to proceed on her passage up Gairloch when the explosion took place. Something connected with the management of the valves is supposed to have caused the accident. Let this be as it may, we are inclined to think that the melancholy loss of life will be the means of putting an end to the high pressure system of propelling steamers on the Clyde. We have heard that four of the dead belong to Glasgow, and formed a part of a company of eight painters who had gone down to paint a house on the banks of Gairlock. Mr. Hedderwick, of the late firm of Hedderwick & Co., shipbuilders, is among the missing.—*Glasgow Chronicle, March* 21.

Railway Mag. March. 1842.

Vapours in Smelting Furnaces.

M. Eblemen read a memoir before the Paris Academy of Sciences, Feb. 1, on the nature of the various vapours developed in smelting furnaces, as observed at different altitudes within the furnace. The object of such researches was to determine the degree of heat at various points, and to devise means for the improved regulations of the fires. He has arrived at the following results—1. The gaseous vapours, on coming out of a furnace heated by charcoal or wood, contain watery vapour, carbonic acid, and oxides of hydrogen and azote, but no carbonated hydrogen. At six or eight feet below the mouth of the furnace the watery vapour is not found, and the proportion of oxide of carbon increases, while those of hydrogen and carbonic acid diminish, according as the observations are made lower and lower down in the furnace.—2. When coal is used jointly with wood for heating the furnace, the carbonization of the vapours takes place in an internal zone, and the water is expelled from the metal at a very [illegible]le. He found that the proportion of gas which traverses a [illegible]ne of the furnace per minute, is greater according as it is [illegible]m the bottom of the furnace.

Athenæum, Feb., 1842.

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Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Reaction Water Wheels used in the United States; and on the Turbine of M. Fourneyron, an Hydraulic Motor, recently used with the greatest success on the continent of Europe. By Ellwood Morris, Civil Engineer.

By way of preface, following a similar classification to that indicated by the celebrated Smeaton, in his experiments on water wheels, we may, with propriety, rank these hydraulic motors under three general heads, to which, *directly or indirectly*, they may all be referred. Viz:

1*st class.* *Wheels actuated by pressure*, such as overshot wheels.

2*nd class.* *Wheels actuated by impulse*, such as undershot wheels.

3*rd class.* *Wheels actuated by impulse and pressure combined*, such as breast wheels.

It is evident, however, that this last class may be made to vanish into either of the others, according as pressure or impulse is mainly applied; and in perfect strictness, all water wheels, may be brought under the *third class*, for even overshot wheels are actuated in part, though it be but a small part, by the impulse of the water issuing into the buckets; whilst undershot wheels, though mainly impelled by impulse, owe a small part of their motion to pressure, for the water striking the floats in a thin sheet, follows and rises against them, so as to bring a certain pressure into play, more especially if it be discharged against

the wheel a little above its bottom, and then confined by a sweep, as is often done.

Yet as in making almost any general classification of machines, we are under the necessity of ranking them according to their *prevailing characteristics*, the above nomenclature is perhaps as expressive as any we could adopt for general purposes, and certainly has a basis in well understood practical distinctions.

Each of these classes has a particular ratio of effect, produced by a given power expended; this ratio is usually expressed by a decimal co-efficient, assuming the power to be unity; and is here regarded as applying to the total fall of the water, or to the *head and fall*, as it is usually termed.

Thus in wheels of the

1st class, the co-efficient of effect	is usually	from		0.700 to 0.800.
2nd class,	do.	do.	do.	0.350 to 0.400
3rd class,	do.	do.	do.	0.500 to 0.600

The *co-efficient of effect* of wheels of the first class is assumed for our present purposes at 0.700 to 0.800, in consequence of the able experiments of the Franklin Institute having shown that under favorable circumstances, even *eighty-four per cent.* of the power expended may be realized by overshot wheels; whilst Smeaton's experiments developed a ratio of power and effect of 3 : 2, giving 0.666 for the co-efficient of effect.

The same co-efficient for wheels of the second class, is deduced from that of the first, by the comparative ratio shown by Smeaton to subsist between overshot and undershot wheels, viz: that the latter, in situations adapted to their use, realized but *one-half* of the useful effect attained by the employment of the former at proper sites.

This co-efficient has been collaterally verified, in experiments made by French officers upon *wheels of impulse* at Toulouse, of the species we call *tub wheels,* of which the ratio of effect to power proved to be 0.342 to 1.

We shall hereafter see that *reaction water wheels,* which we regard as *wheels of impulse,* or as belonging to the second class, had, in one experiment, also a co-efficient of 0.400; that in another where the precise ratio could not be determined *directly,* it was *indirectly* found, by showing that the wheel under trial returned an available effect but *half as great* as a wheel of the first class, and that, therefore, as a necessary consequence, its co-efficient of effect must have approximated in that case also to 0.400; and it will be further shown, that, tried upon a low fall for several years, reaction wheels proved to be inferior in economy of water, to common breast wheels, whence the conclu-

sion is inevitable, that their co-efficient in this case *must have been* less than 0.500.

On the other hand, the *turbine* of M. Fourneyron, has been proved by the able experiments of Capt. Morin, to have a co-efficient of 0.700 to 0.780, or to realize a useful effect, of about three-fourths of the power expended; which is very nearly coincident with that which we have assigned to the *wheels of pressure*, or those of the first class, amongst which we place the *turbine.*

We will finally mention the position in the scale of effect, which it seems to the writer, may be fairly assigned to the various water wheels *in common use.*

1st class. *Wheels of pressure.*—Overshot wheels, pitch-back wheels and turbines; *co-efficient* = 0.700 to 0.800.

2nd class. *Wheels of impulse.*—Undershot wheels, tub wheels, flutter wheels, and reaction wheels; *co-efficient* = 0.350 to 0.400.

3rd class. *Wheels of pressure and impulse combined.*—Breast wheels; *co-efficient* = 0.500 to 0.600, but upon low falls where they are commonly employed, rarely exceeding 0.500.*

As it is not by any means our purpose however, to enter into a general discussion of the subject of water wheels—which has been already confided, by the Franklin Institute, to a very able committee, engaged in elaborating, and publishing, the valuable results that flow from a prolonged series of experiments, made by them some years since—and having already said enough upon the general question, to enable an idea to be formed of the comparative value of the *reaction* and *turbine* wheels, which are the particular objects of this paper, we will now confine ourselves more strictly to these subjects.

* At Fairmount Waterworks, for example, about thirty gallons expended upon the breast wheels with eight feet fall, raise one gallon ninety-six feet into the reservoirs. *To find the co-efficient?*

$$\frac{30\times 8}{1\times 96}=2\tfrac{1}{2} \text{ whole power expended for 1 raised to the same height.}$$

Deduct power lost by the application to a breast wheel, say *one half*	$=1\frac{1}{4}$
	$1\frac{1}{4}$
Deduct friction of pumps, say 20 per cent.,	$=\frac{1}{4}$
Reduced effect thereof	$=1$

From this rough estimate it appears, that if the friction of the pumps, &c., is 20 per cent., then these breast wheels realize an effect of $1\frac{1}{4}$, for a power expended of $2\frac{1}{2}$, or have a co-efficient of 0.500, which confirms what we have above stated upon this point.

Of Reaction Water Wheels.

Reaction water wheels are a very numerous family, of which the well known hydraulic motor, called Barker's mill, is the parent; those used in various parts of the United States, have usually vertical axes of rotation, and curved buckets, or vanes, against which the impulsive force of the water, (spouting from within the wheel by ajutages of which the curved vanes form the sides) ***acts indirectly***, or rather ***reacts***, thus producing (in reference to the effluent water) a ***backward rotary motion***, similar in character and effect, to the ***forward rotary motion***, produced by direct impulse in the case of undershot wheels.

It is only, comparatively speaking, quite recently that reaction water wheels, of the form at present in use in the United States, have occupied a prominent position before the public.

In 1830, Calvin Wing took out a patent for a *reaction water wheel*,* with curved vanes of the figure shown in the annexed horizontal section, in which A is the place of the vertical shaft, C C the curved vanes or buckets, *e d* lap of the vanes; the width of the orifice at *e* being always *less* than at *d*.

In this species of wheel the water has free entrance to the circular space within, and spouting out by the openings between the curved vanes, impels the wheel around in a backward direction, by its *reaction* against the vanes, in issuing, *with velocity*, from within the wheel.

Fig. 1. Fig. 2.

Fig. 1 shows *a double reacting wheel* placed on a horizontal shaft S, the penstock being marked A, the cistern or feeding reservoir

* See specification in the Journal of the Franklin Institute, vol. vii, p. 86, some of the illustrations of which are reprinted above.

B, and the two water wheels respectively D and D, which revolve in vertical planes as indicated in the cut.

Fig. 2 is *a double reacting wheel* on a vertical shaft, A being the penstock, B the cistern or feeding box, and D, D, the water wheels revolving horizontally.

Mr. Wing in his specification lays considerable stress on the necessity of causing the vanes to lap by each other, in the ratio of one and a half inch lap, for each inch of the width of the ajutage, or shortest horizontal distance between any two adjacent vanes; he proposed also to employ his wheels either upon vertical or horizontal axes, and they have been made and used in both ways, as shown in the cuts.

Wing's patent is the earliest one referring to this general form of *reaction water wheel*, which the writer, in a brief search, has been able to find on record; but he has good reason to believe that reaction wheels remarkably similar, if not exactly the same in principle and outline, were tried upon the Brandywine, and abandoned, some years previous to 1830; and that therefore the invention had been antecedently made, and probably patented before.

Since the date of Wing's patent, many others have been taken out for reaction water wheels, but most of these subsequent inventors, have evinced by their productions, a perfectly accurate knowledge of the wheel patented by Wing, for it is a very difficult matter to distinguish them from it, or from each other, and this striking resemblance in general form, becomes identity as to *principle* involved; and with equal accuracy of workmanship, it would seem to be impossible that they can differ more in effect, than would be the case in as many undershot wheels, built by different millwrights, each according to his own fancy.

This view is confirmed by experiments upon two of the most dissimilar, (hereafter cited,) which indicate, that the *co-efficient of effect* in both cases was about 0.400—in fact coming under the general category of *wheels of impulse*, the writer believes that *reaction wheels* will be found, without exception, to approximate as closely in their results, to the co-efficient of this class, as can or ought to be expected, in practical affairs of this nature.

In the American Philosophical Transactions, 1793, William Waring, a mathematician of celebrity, investigated, analytically, the subject of reaction water wheels, in examining the merits of Rumsey's improvement of Barker's Mill, and the conclusion to which he came, after a train of reasoning based upon scientific principles, was, that they were *merely equal in effect to undershot wheels*.

And he came to the same conclusion from the following brief argument.

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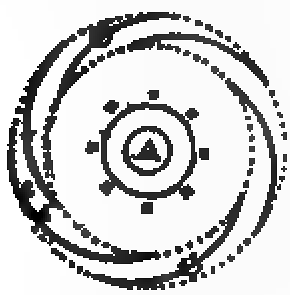


In 1830, Calvin
tion water whe
shown in the
A is the plac
vanes or by
the orifice

In this species of wheel
space within, and spout
vanes, impels the whe
tion against the vane

Fig.

wheels, in com-
of the probable value
valuable, by superseding the
ator (as is usual) was perfectly con-
would speedily do.

action Water Wheel applied to a Grist Mill. *February* 4, 1833.

was double geared, in the usual manner, with beveled
rst motion being given from the vertical shaft of the re-
by a beveled wheel of thirty-five teeth, mashing into
of forty teeth, placed at one end of a lying shaft leading into
mill, on the other end of which was,

The master cog wheel, working into.
The wallower, working into
The counter cog wheel, working into
The trundle head, carrying the millstone.

tones were four feet in diameter, in very bad order, out of
bush loose.

eaction wheel twelve inches under the water in the
under four feet head and fall, being the whole dif-
upper and lower level; ground *very badly* three
of rye, by measurement, in an hour; expense of
le quantity passing over a wasteboard set up
stock, and having a clear fall below.

hty-five inches, depth of the edge beneath
inches; quantity of water discharged,
rmula of Du Buat, as verified by Dr.
ngineers as an accurate mode of
a wasteboard, = 1200 cubic feet

ratus, consisting of a single
either conveyer, hopper-

the time, from this
ly) was, that if it
order, such a wheel in
ess three bushels of wheat
, by the use of 1200 cubic feet
head and fall, *it would be a con-*
ction wheel tried, as could possibly be
ment.

et multiplied by four feet head and fall, and di-
shels of wheat = 1600 *cubic feet of water falling*
minute for sixty minutes, required to grind and dress
*of wheat by this reaction wheel.**

compare, therefore, the work of this wheel with that of others, was only necessary to ascertain the same factor for an overshot wheel, the relation of which, to undershot and breast wheels, having been already determined with practical accuracy by Smeaton; to as-

* This amount of water required, seeming considerably larger than would have been needed by a breast wheel, to do the same work, induced the writer, upon the spot, to declare an opinion unfavourable to the economy of the reaction wheel under trial, in consuming water; which opinion was, of course, but ill received by the sanguine patentee.

And the proprietor of the mill also, where it was erected, was so well pleased with his new wheel, as to be evidently indisposed to hearken to any suggestions adverse to it; consequently the only course was to leave these parties to the action of time and experience, before which no bad machine can long stand; and the result has been that this reaction wheel was long since discarded, by that same proprietor, as incapable of doing the requisite amount of work; whilst the then repudiated breast wheel has been restored to favour and to duty.

"*Action and reaction are equal.*" "But the undersh[ot] propelled by the *action*, and (Barker's Mill) by the *re*[action] same agent, or momentum. *Therefore their mechan*[ical] *be equal.*"

This conclusion, which is strictly accordant wi[th] the information upon this point tends, which it of the writer to collect; was further reference to the elementary laws of Principia; and his article upon this s will be found interesting by such as gate this important question.

In the year 1833, the writer's atte matter in hand, in consequence of to examine for him a *reaction* which he had been invited to been put into use.

In consequence of this ap where a *breast wheel* had make room for this reacti sembled *very closely* th

At this grist mill the it had been put in ac could not, under th its character as m purpose of ascer compared with mon use; wh of the pater common v fident th *Exper*

... 1576 ... required 1600 cubic ... the co-efficient of effect ... lowing proportion.

...6 : : 0.400 : 0.394

...ient of effect in reaction wheels, as inferred ..., assuming the co-efficient of undershot wheels to ..., or nearly coincident therewith.

...te to that which befell this reaction water wheel, the sub- ... foregoing experiment, (as stated in the preceding note) ...wise happened to other wheels of the same species, as we shall ...ention; and will probably also befall, the greater part of those ... use, so soon as the merits of the French *turbine*—that admira- ... hydraulic motor, which possesses all the *advantages*, and none of ... *disadvantages*, of reaction wheels—shall become better known, ... be appreciated, as they will be, when fairly understood.

The American experience which has now been had with the water

* Now if we suppose that under the usual practical circumstances, we can only realise a force equal to lifting two-thirds of the power applied to an overshot wheel, we have then $788 \times \frac{2}{3} = 525$ cubic feet. Then an available work of $525 \times 62\frac{1}{2} = 32,812$ lbs. raised one foot high per minute, *or one horse power of Boulton and Watt's steam standard, will grind and dress one bushel of wheat per hour;* which is easily remembered, and is undoubtedly a *safe practical rule*, erring probably in excess, rather than otherwise, when the mill is well constructed and properly managed.

npulse, commonly called reaction wheels; where fair com-
have been made with them against others, may, in a
gathered from the following history of the proceed-
hed and intelligent manufacturer, (the owner of
ose name the writer does not feel at liberty to
rs upon the subject of his practice with reac-
en placed in the writer's hands by a friend,
in answer to inquiries concerning the

ho had used a number of reaction
ed the patent right of one of the
cuniarily interested in their
f candor and intelligence,
eaction water wheels
he finally adheres to
they are superior to or-
backwater.

manufacturer states,—that at one
d and fall is five and a half feet, *and*
ter trying several reaction wheels, and be-
them, he was about to take out a breast wheel
g and nine feet diameter, with straight floats, and
action wheel of cast iron. The whole tenor of this let-
rable to reaction wheels, though he says with candor, that
willing to express the opinion that where there is no back-
water the reaction wheels will do more work with the same amount
of water than a good breast wheel can perform.

July 20th, 1833.—The same gentleman says he fears that he was too sanguine in his former letter—that three of the new reaction wheels put in action at one of his mills, which were expected to carry 2000 spindles, have proved to be able to carry but 1200—that these wheels consume a great deal of water, and yield but little power in return—that he must get the patentee to see if any thing is wrong—that if they do not perform better he must return to the breast wheel, and use them only as auxiliaries, and finally, "*that reacting wheels are only valuable in backwater, and where there can be no possible want of water to supply them.*"

August 17th, 1835.—The same gentleman, after nearly four years experience in the use of reaction water wheels of the most approved pattern, states, as a summary of his practice, that:

"In backwater they are unsurpassed by any other wheel within my knowledge, for the simple reason that they will run under such head as remains, and running horizontally, and not lifting from the water,

expend no power, as float wheels do, in rising out of backwater. But the power of these wheels depends, like others, upon the head under which they act, and when that head is lessened by backwater, their power is proportionally diminished. I have been each year *supplying the place of these wheels* (the reaction) *with the straight float* (breast wheel) and am now putting in two of the *latter* at one of my mills. The reason is that *the reaction wheels used the water to too great waste, and were continually out of order.* I own the patent right for a reaction wheel,* and have a half dozen on hand for which I have no use. I have also one of Wing's out of use, and of no value to me."

The above recital of the experience of an intelligent, practical man, in the use of these wheels at a site *affected by backwater*, and, therefore, the better suited to develope their peculiar advantages, is, in consequence of his being personally interested in their success, worthy of particular notice, as clearly displaying, firstly, the approval of reaction water wheels; secondly, their trial and doubts of their utility, and finally, their repudiation; which—as though a fondness for these motors was a disease with fixed symptoms and a crisis—are the same stages of opinion that others, who tried them, have passed through in several cases known to the writer; where breast wheels were eagerly discarded for reaction wheels, which, on full and fair trial, were still more eagerly repudiated, to reinstate, the formerly rejected breast wheels.

From a letter addressed by another manufacturer, (located in a different quarter of the country) to the same gentleman whose kindness has supplied us with the above, the following is extracted.

July 14th, 1836.—"The patentees of a reaction wheel offered to put one in for me, that should drive a certain number of throstle spindles, and other machinery *named*, with a certain quantity of water, *also named*, for a stipulated price; and if the wheel when finished would not drive all the machinery mentioned, they should have nothing for putting it in. I accepted their offer, and we entered into a written agreement; they put in the wheel, but they could not make it drive all the machinery they engaged it should, although they used *more water* than was agreed upon. This wheel is geared into the same upright shaft with the breast wheel I had previously put in, which afforded a fair opportunity of testing the power of the wheels; I therefore threw the breast wheel out of gear, and put as much machinery on the *reaction wheel* as it would drive at speed, *and measured the water it was using;* I then put the *breast wheel* in gear, drew water

* This wheel was regarded as one of the very best of the species, all of which are remarkably similar, as we have before stated.

enough on it to make it drive the same machinery, at the same speed it was driven by the reaction wheel, *and measured the water as before,* the difference was considerably in favour of the breast wheel certainly, and if the measurement of the water was correct, *it was quite* 20 *per cent.*"

This *direct* comparison of the work of reaction and breast wheels, made upon a large scale, and under precisely the same circumstances, appears to be absolutely decisive that the former are inferior to the latter, as an hydraulic motor, when the question of *backwater* is left out of view.

Now the ratio of power to effect which commonly obtains in breast wheels, as employed in this country, is about 10 to 5, or their co-efficient of effect may be taken at 0.500; hence if the breast wheel requires, as stated above, 20 per cent. less water to produce the same effect than the reaction wheel did, we have the following proportion to find the co-efficient of the latter, viz:

$$12\frac{1}{2} : 10 :: 0.500 : 0.400.$$

From trial by this manufacturer then, it seems that the co-efficient of effect of reaction water wheels is about 0.400; by our own experiment its value must have been near 0.400, by the experience of the other manufacturer cited, it is clear that it must have been considerably less with his reaction wheels than 0.500, and, finally, by Mr. Waring's investigation, that it was only equal to the undershot co-efficient.

In consequence of all this, we are induced from the information at present in possession, and from some personal observations, to form the opinion, that at least, where they are actuated by a clear fall of water unimpeded below, *the ratio of effect to power in reaction water wheels, is not higher than in good undershot wheels, under the same circumstances.*

If this conclusion is correct (and *if not*, we hope the contrary will be experimentally shown by some of the numerous readers of this journal, who are competent to such researches) it is truly surprising that proprietors of works driven by overshot wheels, with a fine fall, should ever, in any case, have resorted to the use of these *water consumers;* as has been done, to some extent, at the government works at Harper's Ferry, and at a few other points, known to the writer, where *overshot wheels* have been removed to make way for those of *reaction!* which it would appear from the above remarks, *consume twice as much water to produce a given effect, or as much as undershot wheels usually do.*

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cost of Transportation on Railroads. By C. Ellet, Jr., C. E.

[CONTINUED FROM PAGE 147.]

On the Value of Gradients. In the preceding number I proposed a formula for the determination of the cost of transportation on railroads. I am aware that that expression is not in accordance with the opinion which now prevails in regard to the economy of railroad conveyance; and that there are many gentlemen of experience and reputation who are prepared to adopt a much lower estimate than mine. But, until some road can be adduced on which the experiment has been tried long enough to exhibit a result which can be received as a fair average, and which authorizes lower constants, I cannot consent to the reduction of the formula. In its present state it gives a measure below the actual performance on any road in the United States.

I am also aware that, in not presenting the average cost of freight in any particular number of cents per ton per mile; or in any particular sum per mile traveled by the locomotive engines, I have deviated from the popular and most approved methods of treating the subject. But I regard the aggregate cost per mile run as no guide whatever to the economy which characterizes the management of a railroad; and deem it an unauthorized assumption that because this sum is, in any instance, unusually low, the work is conducted with more than ordinary success. The fact, where it exists, can only be used to prove, if other circumstances remain the same, that the engines have taken smaller loads, and made a greater number of trips, and run more miles, than was absolutely necessary. In fact, if we admit, what cannot well be denied—that under similar circumstances, and with engines of the same class, the cost of locomotive power is proportional to the distance run—or that the cost of running one mile is not *diminished* by *increasing* the load, it follows as a consequence that, *cæteris paribus, the more economical the administration of a road, the greater will be the aggregate cost per mile run by the locomotive engines.*

Neither is the circumstance that the aggregate expenses of a line for one year divided by the number of tons conveyed, exhibits a low average per ton per mile, any test of good management. The fact, by itself, is more likely to prove that the tonnage was great than that the administration was judicious.

I shall now proceed to deduce from this general expression of the cost of freight, certain consequences of the utmost importance in the location and establishment of railroad lines, which I believe have hitherto been little, if at all, regarded.

What is the Value of Gradients? I mean by this question, how

much more is a railroad having gradients of thirty feet per mile worth than the same road with grades of forty feet per mile? Or, how much money would good economy authorize an engineer to expend, in the construction of his road, in order to reduce the limiting gradient any given amount?

I have seen various intricate and laborious solutions of questions which involve the loss of *time* and the consumption of *steam* in the ascent of gradients; but I have never yet met with any examination of this interesting and all important problem. The loss of *time*, in this country, is usually a matter of little consequence in the transportation of merchandize; and experience teaches that the cost of motive power is very nearly proportional to the distance traveled by the engine, and very little affected, within the limits which ordinarily occur in practice, by irregularities in the tractile power. It is no doubt true that if we were to make observations under extreme circumstances —as where the engines move on a perfect level, and where they frequently mount the steepest grades they can possibly ascend without loads—the cost of motive power per mile run, would be found to exhibit very considerable variations. The charges for fuel, as well as for repairs, would be materially increased by the increase of the acclivity of the grades. But we have no such extreme cases in practice; and the following investigation is based on the authorized assumption that the cost of running the locomotive engine and its tender, without other load, is proportional to the distance run, and independent of variations of the tractile force consequent on the ordinary irregularities of grade.

In the preceding number, the aggregate annual expenses of a line of railroad under good management were represented by this formula,

$$\frac{3\,N}{10}+\frac{14\,T}{1000}+500h, \qquad \text{(A)}$$

In which N is put for the number of miles traveled, during the year, by the locomotive engines, T the number of tons net carried one mile, and h for the length of the line.

This formula, it will be observed, expresses the cost of transportation without any express computation of the effect of the grades over which the tonnage is carried. Nevertheless, the result which it yields is not independent of the grades; for they enter into the value of N, and control the number of miles traveled by the engines. The variation of the maximum gradient will not cause a sensible variation of any item of the aggregate cost of transportation excepting that of the locomotive power.

Now, in deducing the changes in the cost of locomotive power consequent on changes of grade, I shall assume that the circumstances of the trade are such as will permit that the machine be always started

with a full train—that is to say, with the largest train which it is certain to control on the limiting grade. In many instances this assumption is not strictly in accordance with the facts; since it is frequently advisable—particularly where the grades are light, and the trade inconsiderable—to effect a portion of the transportation with imperfect loads. In such cases greater ascents might obviously be encountered without increasing the cost of carrying every train; and the effect of assuming that the trains are all full, when a portion of them is not full, will evidently be, to render the estimated increase of cost consequent on the gradient somewhat higher than it really is.

The formula is intended to fix *a limit* within which the actual value of the grade must always be found; and as it should be the object of every company to do their transportation with the least possible labour, and at the least possible cost, the number of miles actually traveled ought to approach very nearly the number corresponding with the assumption of full trains; and consequently, except in extreme cases, the estimate should not be much in excess. But if the situation and circumstances of the line be such as will preclude the probability of loading all the tonnage trains to the proper limit, some allowance may be made, in the application of the formula, for that portion of the trade which it does not embrace.

Now, if the limiting gradient of the road be changed, the number of miles traveled by the locomotive engines will also be changed. If the load be reduced one half by the introduction of any plane, the number of trips, and, consequently, the cost of locomotive power, will be very nearly doubled by the admission of that plane.

But the number of miles traveled by the engines in the course of a year, supposing them to convey full loads, and the transportation, accordingly, to be effected with the greatest possible economy of power, will be expressed by

$$\frac{2\,T'}{n} = N,$$

Where n is put for the average gross load in tons, up the limiting grade, and T' for the gross weight in tons carried in full trains one mile in the direction to which that gradient is opposed.

We know, from satisfactory experiments, that an inclination of twenty feet per mile, on a road in good adjustment, requires for its ascent a power nearly double; and one forty feet per mile a power treble, and one of sixty feet a power quadruple (or, for grades under eighty feet, very nearly in this proportion) that which is required to draw the same weight on a level. In other words, if W be the gross load an engine is capable of drawing with safety and certainty on a level road, and x the inclination, in feet per mile, of the gradient which limits the load, then

$$\frac{20}{20+x}W=n$$

will be the load, near enough for our object, with which it can mount the plane ascending x feet in a mile.

If we now designate by C the cost of running the engine with its tender only, one mile; by c the additional cost of motive power per mile, due to each ton gross added to the load—then $C+cn$ will be the whole cost of motive power per mile run. This sum may be written

$$C+c\frac{20\ W}{20+x},$$

by substituting for n its value expressed in terms of the grade and the power of the engine.

If we now multiply this sum by $2\ T'\ \frac{20+x}{20\ W}$, the number of miles that ought to be traveled by all the engines in the course of a year, we shall obtain for the whole annual expense of motive power

$$2\ T'\left(C\frac{20+x}{20\ W}+c\right),$$

and for the whole annual cost of maintaining the line and transmitting the trade which it receives

$$2\ T'\left(C\frac{20+x}{20\ W}+c\right)+\frac{14\ T}{1000}+500\ h; \qquad \text{(B)}$$

in which we have the aggregate cost of transportation, with the greatest attainable economy of power, cleared of the number of miles traveled by the engine, and expressed in terms of the particular grade which controls the cost of power.

In order to determine the sum which we might expend for the reduction of this limiting gradient, which is the problem under consideration, we must ascertain the value of this formula for different values of x, and take the difference between those values.

If we now suppose x to assume the new value x', the corresponding difference produced in the aggregate annual expenses by the change of gradient, supposing still that the trains are full, will be

$$2\ C\frac{x'-x}{20\ W}T'. \qquad \text{(C)}$$

The increase of expenses is proportional to the increase of the sine of the angle of inclination of the gradient; and directly proportional to the gross tonnage which ascends the limiting grade, in full trains, and reciprocally as the power of the engine capable of running one mile at the assumed cost of locomotive power.

The value of gradients, or the expenses which they produce on railroad lines, will diminish, therefore, proportionally to the improvement in the power of the engines.

Let us now substitute for C its value—three-tenths of a dollar—and put $x'—x=1$; and we shall obtain

$$\frac{3\,T'}{100\,W} \qquad (D)$$

for the increase of the annual expenses of a road consequent on the addition of one foot per mile to the acclivity of the limiting slope.

It is not easy to assign the proper measure of the average power of the freight engines now in use; but if we assume 300 tons gross for the maximum load on a level at all seasons of the year, of engines of the medium class—from ten to twelve tons weight—we shall not be too low for the present condition of the machine, and the average power of all good engines of that class.

With this addition to the *data* of the problem, we shall have

$$\frac{T'}{10000} \qquad (E)$$

for the annual value, in dollars, of one foot in the acclivity of the maximum, or limiting, gradient.

If we now capitalize this quantity, or determine from it the original outlay of capital which would be justifiable in order to avoid an increase in the ascent of *one foot per mile*, we shall find it to be

$$\frac{1}{600} \text{ of a dollar,} \qquad (F)$$

or $1\frac{2}{3}$ *mills for each gross ton carried one mile*—the value of money being taken at 6 per cent.

In other words, to find the value of any reduction of the acclivity of the limiting grade, on ordinary railroads,

We multiply the number of tons gross carried up that grade in full trains by the length of the line (or by the distance run by the engines which cross the grade in question,) *and by the number of feet per mile in the ascent which it is proposed to save, and divide by* 600. The result will be the value of the reduction of the grade, in dollars.

There is one point in this annunciation, worthy of remark, and which I believe is never regarded in the consideration of such subjects —if indeed this question itself has ever received any consideration. The amount which may be paid, or ought to be expended, for the reduction of the maximum grade, *is proportional to the length of the road*, if the engines run "through;" or proportional to the length of the "stage" on which the gradient is found, if the line be very long and divided into stages. And this law will continue to apply until it becomes more economical to employ one or more assistant engine to aid in the ascent of such grades; in which case the value of these auxiliary

engines, or the expenses which they involve, limits the sum which may be expended in the reduction of the acclivity.

For the purpose of an application of the rule which I have announced, let us suppose that the road is thirty miles in length; that the duty to be exacted of the engines is equivalent to 20,000 tons gross conveyed "through" in the direction to which the limiting gradient is opposed; and that the cheapest admissable line would present a gradient of fifty feet per mile. How much could we afford to expend, in the construction of the road, in order to reduce this limit to forty feet? By the formula (F) we have

$$\frac{20{,}000 \times 30 \times 10}{600} = \$\,10{,}000.$$

The comparison of this result with the cost which would be actually required, under the circumstances, controls the location. But if the trade in this case had been assumed at 200,000 gross tons, and the length of the line sixty miles, the value of ten feet per mile in the limiting gradient would have been

$$\frac{200{,}000 \times 60 \times 10}{600} = \$\,200{,}000.$$

The magnitude of this last result would, of course, bring up the question of the relative economy of auxiliary power, which would be wholly inadmissible in the former case. Should the comparison determine in favour of assistant engines for the limiting gradient, our equation would then become applicable again to the determination of the value of the next highest gradient, or the sum which might be expended in its reduction.

(To be continued.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Further Notice of the Projected Water Works at Albany.

Mr. Cushman's letter, inserted in the last number of this journal, in which he declares himself "rather pleased the plan should have met with opposition," induces us to offer a few more remarks, with the view of reinforcing some of the positions taken in a review of these proposed works, inserted in the June number.

We will merely premise by saying, that if we have at all *misconstrued* the nature of the plans proposed, it was certainly unintentional, and may probably be owing to the ambiguity of the style in which they were described; of which we could offer examples if mere verbal criticism had any place among our objects.

Whether we have, or have not, *misconceived,* "*what really are the*

results of practice," as is alleged, we freely leave to the decision of our practical readers, most of whom are perfectly cognizant of the facts, upon which our former observations were grounded.

For the sake of convenience, we will still observe the same numerical order, in those of the few paragraphs concerning which further observations are offered, as was observed in the former review, and followed in the letter inserted in the last number.

I. *Concerning the proposed Street Jets for Extinguishing Fires in Albany.*

Mr. Cushman (at page four of the printed report forwarded to the Institute) says "for the extinguishment of fires, *effectually and expeditiously, without other power than that derived from the head of water,* it will be necessary to command a greater head than would suffice to deliver water upon the roofs by a hose or conduit pipe reaching to the roof itself."—"It should be great enough to force upon the roof a *jet d'eau* by means of a short hose applied to the hydrant, &c.," and upon page 5 of the report, he further says, "*an additional ten feet,* at the fountain, will enable us to accomplish this important purpose, *as perfectly as is possible by any exertion of power, &c.*"

Now the parts of the above extracts, which we have taken the liberty of *italicising,* show clearly enough; *first,* a design to dispense entirely with fire engines! and *second,* an expectation that jets through hose from the streets, will rise within ten feet of the altitude of the head of water which actuates them, (or height to which the water would rise in a standing pipe,) that head being either fifty-five feet, "*within the city limits,*" or near 260 feet "*in the lowest part of the city,*" according as we take *the report,* or *the letter* as authority!

It was to combat these apparently erroneous doctrines, that we advanced the case of the jet d'eau at Fairmount, which from what information we then had, was supposed to play only about thirty feet under a head of nearly eighty feet; since then, by the aid of a good theodolite, we have ascertained that when the full opening is drawn, of all its cocks, this jet, actuated by seventy-five feet head, rises forty-five feet high into the air, or falls thirty feet short of the level of the reservoir.

All that we alleged, however, in the former review, viz. that although this fountain is under very favourable circumstances for producing a high ascension of water, yet "*such a jet as might have been expected does not result,*" is still borne out, by the accurate measurements recently made; for (not to multiply authorities) we find by resorting, for example, to Professor Renwick's Treatise on Mechanics

that the altitude of this jet, if deduced from the formula there given, viz:

$$H = \frac{h^2}{360} + h$$

—where H = the head of water above the ajutage, and h = the height of the jet—*should be* sixty-four feet for a head of seventy-five feet—*it is* really but forty-five feet, the practical defect being nineteen feet. Were we not justified then in saying that its altitude is less than "*might have been expected?*" And will not the jets at Albany probably fall short as much?

In fact we might, with apparent safety, infer that the *street jets* at Albany, will fall still more short of the altitude of their active head, than does the one at Fairmount; for it must not be overlooked, that although the form of the ajutage of the latter is not the most favorable possible, for producing the highest projection of water, it is yet more so than the common branch pipe of a hose, as will be readily appreciated.

Again it is perfectly well known here, that notwithstanding the abundance of our usual supply of water, whenever a great fire breaks out, and the fire department have made their attachments to the fire plugs, it is with the greatest difficulty that any water can be procured from the private hydrants in the vicinity, though these are but little elevated above the pavement, and usually about sixty feet below the level of the surface of the reservoirs at Fairmount; and we may further mention, that the ordinary consumption of the city, prevents the water from rising, in *a standing pipe*, at the Navy Yard, on the Delaware front, within nearer than about fourteen feet of the reservoir level; now if projected from the pavement by a hose, it would of course fall much more short—probably, indeed, forty feet short in all—and as the usual city supply must go on at all times when it is required, how can only ten feet additional head be expected to control fires by *street jets?*

Of course isolated cases will, and do sometimes, occur, when a single hose attached *promptly*, may subdue a fire in its inchoative state; but they are not common, and it would certainly never answer, to rest the safety of a large city upon the possible contingency of attacking every fire, in its very inception; an apparatus must therefore be kept, and a department organized, capable of making head against, and extinguishing, a considerable conflagration; and being so kept, and always ready to act, the occasional importance of a single jet, dwindles into insignificance, or even vanishes entirely.

Mr Cushman, in his letter p. 147, in speaking of the fountain at

Fairmount, says: "Now the *essential circumstance* of the trial having been made with a single ajutage of *one inch* in diameter, has been entirely overlooked, while it is 'a stubborn fact' that with a plentiful supply of water and given height of fountain, *the height of the jet may be increased* through *a very great range*, simply by varying the size of the orifice of the ajutage. My plan had due reference to this appropriate orifice for the jet, and the writer's opposition to it arises from a want of knowledge of any such requirement."

Upon this very point in Cavallo's Philosophy, p. 221, 4th Am. Ed., we find the following remarks.

"By enlarging the aperture the friction against the sides is diminished, but the friction or opposition of the air is increased. Therefore as long as the former is diminished faster than the latter is increased, the jet may be made to ascend higher and higher, by enlarging the aperture; but beyond that limit, the enlargement of the aperture will not increase the height of the jet. Now it has been found *from a variety of experiments*, that this limit, or maximum of effect, takes place when the diameter of the circular aperture *is somewhat less than an inch and a quarter.*"

Now as it seems absurd to suppose that to produce "*a very great range,*" in speaking of a *one inch* jet, Mr. Cushman intended only *one quarter of an inch* variation in the size of the orifice of the ajutage, and as Mr. Cavallo explicitly declares, in the above extract, that the ajutage of a jet of maximum altitude, with a given head, *requires* to be one and a quarter inch *only*, we are impelled to the conclusion that the phrase "*very great range, &c.,*" could only have been used in this connexion, from "*a want of knowledge of any such requirement.*"

Be this as it may, we *did not* mistake the "individual fact" at Fairmount for "*a principle,*" as is alleged, but merely regarded it as *an instructive example, pregnant with meaning;* hence we feel but little interest in this part of the discussion, and leaving Mr. Cushman to settle with Mr. Cavallo the question of variation in the size of the ajutage, and the extent of range through which jets may thereby be augmented in altitude, we will now pass to other points.

III. *Of the thickness of Cast Iron Conduit Pipes.*

In commenting upon this subject in our review, we referred to the fact, that *long practice* had established the necessity of giving to conduit pipes, a thickness *very much greater* than would be deduced by a mere calculation, based, in any given case, upon the known working pressure of water, the known tenacity of cast iron, and perhaps a small addition for corrosion.

In our review we attempted, upon sheer practical grounds, to combat the fatal doctrine, that "one-twentieth of an inch is amply sufficient to sustain the pressure resulting from a head of fifty-five feet," even if subsequently proposed (on account of probable corrosion) to be augmented fivefold, or only to *one-fourth of an inch in thickness*, for cast iron conduits of seventeen inches calibre, working under fifty-five feet head!

Far from regarding such pipes as possessing so large a surplus of substance that "we may certainly rely upon the efficiency and durability of the conduit" if working under fifty-five feet head; we were impelled to conclude from practice here, that such a conduit would *necessarily fail* to realize the expectations formed of its utility.

For it is to guard against contingencies from without, as well as the pressure from within, that experience has shown a thickness of *two-thirds of an inch*, to be indispensable for our water pipes of sixteen inches calibre, working in the general plane of the city, under a pressure about the same as is proposed at Albany; amongst the chief of these contingencies may be named the settlement of the earth above them, in which they are buried; it would appear that the hubs, or projections, at the end of each nine feet length of the conduit pipes, rest usually upon a solid foundation formed of undisturbed earth, whilst the body of the pipe often scarcely touches at all, it being very difficult so to pack the earth around, and below it, as to secure an uniform bearing.

To show what great errors we should fall into, by founding an estimate of the necessary thickness of conduit pipes upon a mere calculation of the pressure within them, we will refer to the case of the gas pipes of Philadelphia, which work under a pressure equivalent only *to three inches head of water;* now these pipes, if proportioned to the pressure within, upon the supposition that "one-twentieth of an inch is amply sufficient" to sustain a head of fifty-five feet (as stated on p. 15 of the printed report) would scarcely be thicker than this sheet of paper! Let us inquire what is the actual thickness in use in Philadelphia? The able superintendent of the gas works has informed the writer, that their sixteen inch mains are made about five-eighths of an inch thick, and that, as a general rule, they give to the gas conduits *only ten per cent. less substance than practice has assigned to those of similar calibre which convey water through the city.*

Such being the case here, we invite our readers to calculate the minute fraction of an inch, which would represent the thickness of cast iron gas pipes, upon the supposition that *the pressure alone* should be regarded, and ask themselves whether such attenuated tubes could be, for a moment, thought of *for actual use;* for we may probably be

told that the thickness commonly allowed for gas pipes *every where*, which far exceeds what the mere pressure within would require, is one of the "errors of practice" that ought to be repudiated; though such an allegation would more likely be regarded by impartial people as *an error* in him who ventured the assertion.

V. *Concerning the separate lengths of the Conduit Pipes.*

The fact that in practice the hubs of pipes are likely to, and do often actually, become fixed points of support, is a very strong argument (amongst others) against increasing their length from nine to fifteen feet; more especially, when at the very same time that it is proposed to increase the lengths of the pipes, and thus essentially augment the stress upon them; it is also (most singularly) proposed, greatly to reduce the thickness assigned them by practice, so as very much to diminish their ability *to support that augmented strain!*

VII. *Concerning the velocity of the water in the main rising from the pumps.*

The writer has been informed on good authority, that soon after the present works at Fairmount were first put in operation, numerous experiments were made with the view of determining the most advantageous velocity at which to work the wheels and forcing pumps; these trials were commenced with about fifteen revolutions per minute of the wheel, when driving the double forcing pump with five feet stroke each way, or with a velocity of water in the rising main of 150 feet per minute; at which speed every thing worked smoothly and well; but as this celerity gave to the wheel, at the skirt, a velocity of nearly twelve feet per second, it was thought desirable to diminish it; and accordingly trials were made, by reducing the motion successively, one revolution at a time, until the number of turns of the wheel in a minute was reduced to twelve, or the speed in the rising main to 120 feet per minute; *still all worked well,* and so continued until the speed was somewhat further reduced; but it was soon after discovered that during the instants of time, when the piston was changing its direction at either end of the pump barrel, a recoil of the ascending column began to take place at these intervals; *owing to the momentum not being kept up whilst the piston cleared its dead points;* and when the speed was reduced as low as eight turns of the wheel in a minute, or the ascending rate to a velocity of eighty feet per minute, (still fifteen feet per minute *greater* than is proposed at Albany,) the recoil at each end of every stroke of the force pump, became so serious as to cause the shocks to be very perceptible, like the pulsations of an ‑ulic ram, the joints of the pump began to open and leak, and ‑cessive shocks threatening to blow up the working tube, the

experiments were discontinued by the superintendent; he having satisfied himself *that a velocity of about* 120 *feet per minute for the water in the rising main*, was, in view of every thing, the most suitable speed at which to operate these works.

This is not a *theoretical* conclusion, but *an experimental result* of a very significant character; one that will neither be misunderstood, nor disregarded, by any practical man who feels a proper anxiety for the success of works committed to his charge; and we submit, whether it does not entirely justify the remarks formerly made by us upon this point.

Finally, being quite content to rest the case, in connexion with the other points mentioned in our review in the June number, upon the issues made upon the arguments formerly advanced, and having already occupied, with these remarks, much more space than had been originally designed, we will now take a final leave of the subject by expressing the hope, that before the "Projected Water Works at Albany" are put in hand for execution, *the plan* may be more maturely considered by the respected engineer, lest in after times some future projector of water works, may point to them as instructive examples of "*the errors of practice.*" M.

Facts and Observations on Four and Six Wheel Engines. By John Herapath, Esq.

[CONTINUED FROM PAGE 160.]

Glasgow and Ayr Railway.—This is one of the lines upon which I was unable to go, but respecting the locomotives of which, however, I have been favoured with some information. The total length of this line is forty miles, as it appears from an article on the Glasgow and Ayr Railway, in the 35th No. of the octavo series of the R. M.; that is, seven miles from Glasgow to Paisley, ten to Johnstone, fifteen to Lochwinnoch, nineteen to Beith, twenty to Kilburnie, twenty-three to Dalby, twenty-nine to Kilwinning, thirty to Irvine, thirty-three to Troon, and forty to Ayr. The present amount expended is something under £ 20,000 per mile.

The steepest gradient of this line is eleven and three-fourths feet a mile, and there is no sharper curve than a mile radius, except at the Glasgow terminus, where it is 1200 feet. For the curve of a mile radius the outer rail is elevated three-fourths of an inch. The locomotive stock of the Glasgow and Ayr Railway, consists of twenty engines; eight made upon Mr. Bury's plan, that is four wheel engines, with inside bearings, and the other twelve are made upon the plan of the Company's Engineer, Mr. Miller. These are six wheel engines, and have inside bearings. The weight of the six wheel is thirteen and a half tons; their weight on the driving wheels is six tons, (query, seven tons) and on the other wheels three and a quarter tons each.

The weight of the uncoupled four wheels is ten tons, and of the only two coupled engines they appear to have, thirteen tons, of which the weight on the driving wheels of the uncoupled four wheels is six tons, and on the other wheels four tons. In the coupled engines the weight is equally distributed.

Of these engines nineteen are in a fit state to leave the station with a train, and the twentieth one, at the end of November last, was expected to be ready in a few days. The driving wheels on the six wheel engines have flanches seven-eighths of an inch deep.

The motion of the coupled engines is less than those four wheel that are not coupled, but it is not thought they have sufficient experience in these matters to speak as to the particular safety or danger of either kind.

From August twelve months, the time the line was opened from Glasgow to Ayr, they have not had more than three detentions on account of derangement of machinery. In neither of these cases was the engine thrown off the line, the detention having been from some very slight breakage in the machinery, or the pumps being out of order, nor has there been any, the slightest, accident to carriages or passengers.

There have been no broken axles whatever.

From the time of the opening to Glasgow, three engines have been thrown off the rails, at the switches near the stopping places, or stations. Two on account of the switchmen having pointed the rails wrong as the engine was entering the station, and the other on account of the connecting rod of the two switch bars having got too much play. In no instance has any damage been done to any passenger, or servant of the Company, or to any carriage. These accidents happened, one with a six wheel engine, and two with a four wheel, all uncoupled. All the driving wheels are five and a half feet diameter, except the two coupled engines, which are five feet. They have thirteen inch cylinders, eighteen inch stroke. The gauge of the rails is four feet eight and a half inches, and the play of the wheels on the rails is half an inch, and the pressure per square inch fifty pounds. The average cost of the six wheel engines is £ 1,320, and of the four wheel £ 1,400. They find the four wheel engines more economical in point of consumption of coke, but in no other respect do they conceive that one kind of engine has any advantage over another. The six wheel consumes forty-two pounds of coke per mile, and eighteen gallons of water; the four wheel forty pounds of coke per mile, and sixteen gallons of water.

Motion is said to be more conspicuous in their four wheel engines than in their six. The four wheel has a slight vertical motion, the six wheel a slight lateral motion, but the engines run so very steadily that motion is scarcely perceptible. These motions, however, whatever they are, they think are due chiefly to the imperfections of the road. The length of their six wheel engines is eighteen feet, and of their four wheel sixteen feet. They have no practical proof that the distance of the cranks from the middle of their axles produces any sinuous or sidling motion. Total mileage per annum is 130,000.

Maryport and Carlisle Railway.—Though I had a very kind invitation from William Mitchell, Esq., the Secretary, I was, for the same reasons as stated in my account of the Great North of England, Glasgow and Ayr, and Ulster Railways, unable to visit this line, which was partially opened July 15, 1830.

They have only two locomotive engines, six wheel and outside bearings. One, a coupled engine, fifteen tons, and the other, an uncoupled, thirteen tons. The coupled engine has about half the weight on the driving wheels, and the uncoupled about ten tons. One of these I understand to be coupled in all six wheels. They find it a safe engine, but the uncoupled one is of little use, for the heavy loads which they carry, namely, 140 tons. The coupled engine has flanches, and the uncoupled has not. One of these engines in November was in a fit state to take a train. They have had no detentions from failure of machinery, nor any broken crank axles, or runnings off the line. The diameter of the driving wheels of the uncoupled engines is five feet, of the coupled four and a half, the other wheels being three and a half feet in diameter. The uncoupled engine has a twelve inch cylinder, and eighteen inch stroke, the other a fourteen inch cylinder and sixteen inch stroke. The smaller engine cost £ 1,400, its tender £ 180. The larger engine and tender £ 1,720. They say the six wheel engine runs smoother on the rough road, but the four wheel takes the curves better. The average consumption of coke is sixty-seven pounds per mile, and the evaporation of water twenty-five gallons. They attribute the motions of the engines to bad road. One engine is rather topheavy from having a high fire box. The extreme length of the engines is sixteen feet. The manager of the locomotives thinks that the distance of the cranks from the centre of the axle produces sinuous motion when the road is slippery, and much more in the uncoupled than in the coupled engine. The steam pressure is fifty-two pounds to the inch. The total distance run is 7,200 miles a year. The steepest gradient in the eight miles now opened is nineteen and one-third feet a mile, and on the part to be opened twenty-five and one-fourth feet.

At one time there was a curve on this line near the terminus of six chains radius, and with an elevation of the outer rail of only half an inch. The present secretary, Mr. Mitchell, reduced the curvature to nine chains radius, and elevated the outer rail to two inches. It is worthy of remark, that on the former curve the engine is described as having great sinuous or eel-like motion, which is now almost entirely obviated on the new curve. This is rather a curious circumstance, as I should have expected that on the curve with a larger radius the sinuous motion would have been more conspicuous. It is, therefore, a question for inquiry, whether the greater elevation of the outer rail has any thing to do with steadying the motion; for it is generally understood that the sole object of the elevation of the outer rail is to balance the centrifugal force.

I understand that the engine has often traversed this curve at the rate of twenty-two miles an hour, with a load of sixty tons after it.

The Ulster Railway.—This was another line upon which of course

I had no opportunity of going, as I did not go out of England. The length opened of this line is twenty miles.

The Company's stock consists of seven engines, all six wheel and uncoupled, with outside and inside bearings on the crank axle. They weigh sixteen tons, of which nine and a half tons are upon the driving wheels. The driving wheels have all flanches, and the whole seven of the Company's engines are in an efficient state of repair. They have had about six detentions of trains, from trifling derangements of the machinery, in two and a quarter years, but no broken crank axles, nor have they had any engine run off the line.

The average cost of their engines is £ 1,500, and of the tender £ 260. Their consumption of coke is thirty-five pounds per mile, and of water twenty-five gallons per mile. The engines are described as perfectly steady. Top-heavy engines are unknown to them.

They have no practical proofs of the influence of the distance of the cylinders from the main axis of the engine producing any effect upon the motion of the engines. The expense of repairs is 11½d. per mile per annum, and the steam pressure is sixty pounds to the inch. The gross average load is from fifty to sixty tons.

York and North Midland Railway.—As a continuation of the main trunk to the north, the York and North Midland Railway forms an important link. Starting from the junction of the North Midland and Manchester and Leeds Railways at Normanton, about ten miles south of Leeds, it pursues a north easterly course to York, crossing the Leeds and Selby Railway about fourteen miles from York, the whole length of the line being twenty-three miles fifty-two chains, or nearly twenty-three and three-fourths miles.

I have already referred, in my account of the Hull and Selby, to some of the engines of this Company upon which I have traveled. Most of them are built by Mr. Robert Stephenson. The two I traveled on with Mr. Cabrey were the *Princess* and the *Victoria.* The latter was a lively and smart engine, and in my opinion better than the former, which I thought somewhat sluggish.

The Company's stock of engines in the middle of January last was thirty-two, eleven of which were taken from the Leeds and Selby Railway when this Company became lessees of that line. The whole are on six wheels, with outside and inside bearings, except the *Prince of Wales,* the late improved patented engine of Mr. R. Stephenson. The weight of the smallest engines is twelve and a half tons. Some are between that and fourteen tons, and others are sixteen tons weight. About one-half the total weight is on the driving wheels, five-sixteenths on the fore-wheels, and the remainder on the hind wheels. They have eight coupled engines, all on six wheels, which work well, are considered safe, and not expensive, considering the loads they take. They are used exclusively for luggage trains. *Most of the engines are without flanches on the driving wheels.* Out of their number they had twenty-six in good working order, and have not averaged one detention a month from any derangement of the engines. In two years and seven months they have had *ten crank axles broken,* none of the engines being able to proceed with the train

after the fracture. The axles had for some time been failing prior to the breaking down, which was attributed to their being too weak, and in some cases to the material being defective. There was only one of these a coupled engine. Five of them broke down near the station, while moving very slowly, and of course at a great strain; the others, while ascending an easy gradient on a slight curve. No accident or injury happened to any one. In no instance has an engine run off the rails except by the points being wrong. Three of the broken axles were five inches in diameter. The cost of the engines is from £1,300 to £1,600. They give a preference to six wheel engines, thinking them safer than four wheel. The gross average weight of the passenger trains is fifty tons, and average consumption of coke twenty-five pounds per mile, and for goods trains thirty-eight pounds. The motions observed are a slight pitching, rolling, and sinuous motions, which they say are most conspicuous in ascents, descents, and curves, and always arise from imperfection in the road, assisted at times by the wheels wearing out of truth. They have no top heavy engines, nor have they any practical proof that the distance of the cranks from the centre of the axle has any effect on the sinuous or sideling motion of the engines, but Mr. Cabrey thinks it probable that if the cylinders were outside the wheels, the sideling motion would be increased.

The steam pressure is sixty pounds per square inch. The distance run by the passenger engines during a year is 289,600 miles, and by the luggage engines 212,200. Including their main line and branches, and the Leeds and Selby which they lease, they work about forty-eight miles of railway. The oldest of the York engines is three years; some of the Leeds and Selby six years, but the engineer thinks the age of the engine does not affect its steadiness, provided the engine is in good order.

It was upon this line, if I remember rightly, that I was informed by the engineer that, whenever there were any fractures of the axles of wagons, it generally happened upon the stone blocks. They are in the habit of taking coal wagons of other parties, in the make of the axles of which, so much care is not bestowed, as if they were made for the Company, and hence, when they come to travel at a rapid rate, loaded, over their line, if they are disposed to break they almost always do it were the percussive effects are the greatest, that is, upon the stone blocks. *In fact, it appears to be generally established by experience, that stone-blocks are objectionable upon railways, and more fruitful in accidents (which they occasion from their rigidity,) than either cross sleepers, or continuous wooden bearings.*

[To be continued.]

Mr. Vignoles' Lectures on Civil Engineering, at the London University College.

[Continued from page 162.]

On Retaining Walls.

Lecture VII.—Wednesday, January 5th, 1842, Professor Vignoles commenced by stating that he had then reached the third division of

the first course, and his present lecture would be upon retaining walls. The meaning of the technical terms of "retaining" and "sustaining" walls was—when a wall was used either to support water or earth artificially put together; but when it was used to support natural earth, it was often called a "breast-work." As the term "batir" would often be made use of in that and the following lecture, he proceeded to explain that the batir was the base of a triangle, formed by the slope of the wall and perpendiculars of the other two sides—thus a battering wall was a sloping wall. The introduction of retaining walls was very ancient; in Italy there were several of great antiquity, formed of concrete, rubble, &c., and even some parts of the Great Wall of China was built in that way. Retaining walls were generally introduced at the ends of bridges, to connect the abutments of the bridge with the natural ground; but in these cases they were called "wing walls." In forming roads, retaining walls were sometimes carried along the sides of valleys—the road itself having to be cut at times along the sides of hills so precipitous, that half was embankment and half cutting. In the celebrated road formed by Napoleon across the Alps, there were many instances of work of this kind, and good lessons could be learnt from the failures which had taken place, the reasons for which were generally very apparent. In Telford's grand road through Wales, there were many instances of retaining walls, and one in particular, where the road had to pass along the side of a hill which was nearly perpendicular. The great cutting from Camdentown to Euston-square was another instance, but, from certain causes, which he very ably explained, the walls were giving way in many places. He then proceeded to lay down, by numerous diagrams, seven forms of retaining walls made use of; and pointed out, by mathematical formula and practical experiments that had been made, and which the diagrams explained, the best forms for use. In No. 1 the batir was represented as being equal on each side of the wall; in No. 2 the batir was on the side next the earth to be supported; No. 3 was a parallel batiring wall; in No. 4 the batir was next the earth, but at the bottom of the wall, No. 5, the batir was on the outside, at the top; No. 6, was a parallel and perpendicular wall, with no batir on either side; and No. 7 had the batir at the outer side of the wall, and next the earth the slope was cut in steps; these seven diagrams showed the common forms of retaining walls. The grand points to be considered, were—1st, the value of the pressure that the earth exercised against retaining walls; and, 2d, the description and dimension of the wall necessary to offer sufficient resistance to that pressure. It was found that if you take away the wall, the earth will for a short space of time retain its position, but, after exposure, it will begin with crumbling at the edges, and ultimately gain a slope so as to lie at the angle, which is called the "angle of repose;" this requires, in building retaining walls, that the angle of repose of the description of earth to be supported should be ascertained; this done, the pressure to be resisted might be calculated, and the dimensions of the wall be decided upon accordingly. Of all the descriptions of retaining walls No. 3 was the one which offered

the most support with the least quantity of material, and which had, by experiments made at Dublin under the direction of Sir J. Burgoyne and the Board of Public Works of Ireland, been fully proved. The Professor then explained the nature of the several experiments, and the effects upon the walls, exemplifying them by very instructive diagrams. The attention of the students was next called to the curvilinear batir, and several very interesting cases were adduced of failure in that plan, from various causes, but principally from water. He then alluded to two or three failures of his own, and fully explained to the students the causes of them, and the means he should have adopted in the first instance for their prevention. The occasional supporting of walls was judicious in various instances; suppose there was a case, that, while the earth was in an unsettled state, the pressure against the wall was double what it would be when it had settled; in such a case he would recommend supporting walls until the settlement took place—not to go to double the expense for a temporary purpose. He then mentioned a very remarkable instance of an abutment, which was practically a retaining wall, giving way. He had to make an arch of twenty feet span for a river, through an embankment eighty feet high; the foundation was rock, but a sudden lurch took place in the body of the embankment, and the earth forced its way through very many feet of sand backing, drove the abutment or retaining wall clean off the rock, and moved the whole twelve or thirteen feet. Several good rules were then laid down to calculate the description of wall to be used, and method of giving a temporary support until the earth settled; and the learned lecturer, in conclusion, stated that his next lecture would be given on Wormwood Scrubbs, where there were some most remarkable instances of failures in retaining walls, the reason of which he could better explain on the spot than by diagrams.

On Atmospheric Railways.

Lecture VIII.—Monday, January 10th, 1842.—This being intended as a practical illustration of some interesting and important points, the lecture was delivered on the works of the railways situated at, or near, Wormwood Scrubbs, in place of being given, as usual, in the lecture room of University College.

The first point to which Mr. Vignoles directed the attention of the class was to the atmospheric railway, or rather a portion of railway laid down on that principle for experimental purposes, upon the line belonging to the West London Railway Company. The length of this experimental line is half a mile, and, according to the Professor's statement, it fully answered the purpose, and he, at some length, and with great ingenuity, explained the principles of the system. The iron tube first attracted attention; it is nine inches in diameter, with a grooved slit along the upper surface, which is closed by means of a valve of leather, strengthened by plates of iron, flat on the outside, and forming the segment of a circle on the inside, so as to complete the diameter of the tube when it is shut; at the edge of the valve is a composition of bees' wax and tallow, which renders the tube air tight.

Next was examined the carriage, to which was attached a piston, fitting into the tube, and a very ingenious contrivance was shown, by which the valve was first opened and afterwards closed down, immediately after the piston had passed, however great the velocity of the carriage. The impossibility of procuring a perfect vacuum had long been assigned as the great objection to this principle of producing locomotion; but Professor Vignoles showed that a good working half vacuum was, by the simple contrivance he had explained, quite attainable, and sufficient for practical purposes. The engine and air-pump were next severally examined and explained, and the lecturer then gave some very interesting explanations of matters connected with the present experimental railway; he stated that the air from the half mile of tube could be extracted in about one minute, while it would take nearly eight minutes for the leakage of the valve and air-tube to admit the air to fill the tube. In consequence of the imperfections in the present line, which had been merely laid down for experiment, the leakage was very much more considerable than when a perfect line should be formed for service, and the formation of a railway on the atmospheric principle would not exceed, perhaps, one-third of the cost of many of the great lines hitherto contracted for, as it would do away with much of the cutting and embankment, the slips of which had recently been so troublesome and dangerous, by the trains being able, on this method, to ascend considerable acclivities. The present experimental line had a rise of about one foot in 110, and he had gone along at the rate of forty-five miles an hour, notwithstanding the imperfections of the machinery and the wretched state of the line; he pointed out that it would be practicably impossible for a locomotive to travel upon such a line, as it would be off the rails immediately, in consequence of their being so uneven and loose; yet he had traveled at the rate he before mentioned, with perfect ease and safety; and, furthermore, the extreme simplicity of the machinery rendered it very unlikely to get out of order. A few weeks back the line was required suddenly for some experiment, and, although the tube was half full of ice, in less than half an hour every thing was in readiness, and the trial was very satisfactory. The power obtained by the present small tube is 1760 lbs., with an atmospheric pressure of about eight pounds per inch only. The engine employed to work the air-pump is sixteen or eighteen horse power, and the economy of stationary over locomotive power was admitted by every body. He concluded his remarks upon this interesting, and what promises to be most useful, application of the power of atmospheric pressure, by detailing, at some length, the minutiæ of the saving that would be effected by its general adoption, and stating that two miles were to be laid down upon the Dublin and Kingstown Railway, to try the experiment upon a larger scale, with a tube fifteen inches in diameter, and more perfect apparatus. The Professor then, as the party walked along the line, pointed out to the class various slips that had taken place, some of which were slight, and others extensive; one part in particular, situated between the Great Western and London and Birmingham Railways (which are here within a quarter of a mile of each

other,) attracted general attention, the whole, for nearly 100 yards, being a perfect chaos. A remarkable instance of a failure of a retaining wall here presented itself, it having, for about forty-five yards, been actually pushed forward off the foundation, to a distance of eight or ten feet, the wall still standing, which appeared to be about four feet thick, strongly built of brick and concrete and strengthened with bands of iron and wood. The causes of this destruction were explained by Mr. Vignoles as arising from the lodgment of water, which, having no outlet, had settled the earth against the back of the retaining wall, turning the clay into mud, and, by the great additional weight, forcing it into the position in which it now appears. If the water had been cut off in time this would not have happened, and that water was the occasion of this accident seemed very apparent. The lecturer then pointed out the manner of supporting retaining walls. Several portions of the London and Birmingham and Great Western Railways were then examined, and much valuable information was given on the various contrivances made use of by these companies, and he concluded by appointing the class to meet on the Croydon and Brighton Railways the next morning, to proceed to the great slip near New Cross.

[TO BE CONTINUED.]

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. Dumas.

[CONCLUDED FROM PAGE 175.]

V. An animal, in fact, constitutes an apparatus of combustion from which carbonic acid is continually disengaged, in which, consequently, carbon undergoes combustion.

You know that we were not stopped by the expression *cold-blooded animals,* which would seem to designate some animals destitute of the property of producing heat. Iron which burns vividly in oxygen produces a heat which no one would deny; but reflection and some science are necessary in order to perceive that iron which rusts slowly in the air disengages quite as much, although its temperature does not sensibly vary. No one doubts that lighted phosphorus in burning produces a great quantity of heat. Unkindled phosphorus also burns in the air, and yet the heat which it developes in this state was for a long time disputed.

So as to animals; those which are called warm-blooded burn much carbon in a given time, and preserve a sensible excess of heat above the surrounding bodies; those which are termed cold-blooded burn much less carbon, and consequently retain so slight an excess of heat, that it becomes difficult or impossible to observe it.

But, nevertheless, reflection shows us that the most constant character of animal existence resides in this combustion of carbon, and in the development of carbonic acid which is the result of it; beginning,

also, in the production of heat, which every combustion of carbon occasions.

Whether the question be of superior or inferior animals; whether this carbonic acid be exhaled from the lungs or from the skin, does not signify; it is always the same phenomenon, the same function.

At the same time that animals burn carbon, they also burn hydrogen; this is a point proved by the constant disappearance of hydrogen which takes place in their respiration.

Besides, they continually exhale azote. I insist upon this point, and principally in order to banish an illusion which I cannot but believe to be one of the most prejudicial to your studies. Some observers have admitted that there is an absorption of azote in respiration, but which never appears unaccompanied by circumstances that render it more than doubtful. The constant phenomenon is the exhalation of this gas.

We must therefore conclude with certainty, that we never borrow azote from the air; that the air is never an aliment to us; and that we merely take from it the oxygen necessary to form carbonic acid with our carbon, and water with our hydrogen.

The azote exhaled proceeds, then, from the aliments, and it originates in them entirely. This, in the general economy of nature, may in thousands of centuries be absorbed by plants which, like Jerusalem artichokes, draw their azote directly from the air.

But this is not all the azote which animals exhale. Every one gives out by the urine, on an average, as M. Lecanu has proved, 230 grains of azote a day, of azote evidently drawn from our food, like the carbon and hydrogen which are oxidised within us (que nous brûlons.)

In what form does this azote escape? In the form of ammonia. Here, indeed, one of those observations presents itself which never fail to fill us with admiration for the simplicity of the means which nature puts in operation.

If in the general order of things we return to the air the azote which certain vegetables may sometimes directly make use of, it ought to happen that we should also be bound to return ammonia, a product so necessary to the existence and development of most vegetables.

Such is the principal result of the urinary secretion. It is an emission of ammonia, which returns to the soil or to the air.

But is there any need to remark here, that the urinary organs would be changed in their functions and in their vitality by the contact of ammonia? the contact of the carbonate of ammonia would even effect this; and so nature causes us to excrete urea.

Urea is carbonate of ammonia, that is to say, carbonic acid like that which we expire, and ammonia such as plants require. But this carbonate of ammonia has lost of hydrogen and oxygen so much as is wanting to constitute two molecules of water.

Deprived of this water the carbonate of ammonia becomes urea; then it is neutral, not acting upon the animal membranes; then it may pass through the kidneys, the ureters, and the bladder, without inflaming them: but, having reached the air, it undergoes a true fermentation, which restores to it these two molecules of water, and which

makes of this same urea true carbonate of ammonia; volatile, capable of exhaling in the air; soluble, so that it may be taken up again by rain; and consequently destined thus to travel from the earth to the air, and from the air to the earth, until, pumped up by the roots of a plant and elaborated by it, it is converted anew into an organic matter.

Let us add another feature to this picture. In the urine, along with urea, nature has placed some traces of albuminous or mucous animal matter, traces of which are barely sensible to analysis. This, however, when it has reached the air, is there modified, and becomes one of those ferments of which we find so many in organic nature; it is this which determines the conversion of urea into carbonate of ammonia.

These ferments, which have so powerfully attracted our attention, and which preside over the most remarkable metamorphoses of organic chemistry, I reserve for the next year, when I shall give you a still more particular and full account of them.

Thus we discharge urea accompanied by this ferment, by this artifice, which, acting at a given moment, turns this urea into carbonate of ammonia.

If we restore to the general phenomenon of animal combustion that carbonic acid of the carbonate of ammonia which of right belongs to it, there remains ammonia as the characteristic product of urine.

Thus, by the lungs and the skin, carbonic acid, water, azote.

By the urine, ammonia.

Such are the constant and necessary products which exhale from the animal.

These are precisely those which vegetation demands and makes use of, just as the vegetable in its turn gives back to the air the oxygen which the animal has consumed.

Whence come this carbon, this hydrogen burnt by the animal, this azote which it has exhaled in a free state or converted into ammonia? They evidently come from the aliments.

By studying digestion in this point of view, we have been led to consider it in a manner much more simple than is customary, and which may be summed up in a few words.

In fact, as soon as it was proved to us that the animal creates no organic matter; that it merely assimilates or expends it by burning it (en la brûlant,) there was no occasion to seek in digestion all those mysteries which we were quite sure of not finding there.

Thus, digestion is indeed but a simple function of absorption. The soluble matters pass into the blood, for the most part unchanged; the insoluble matters reach the chyle, sufficiently divided to be taken up by the orifices of the chyliferous vessels.

Besides, the evident object of digestion is to restore to the blood a matter proper for supplying our respiration with the ten or fifteen grains of coal, or the equivalent of hydrogen, which each of us burns every hour; and to restore to it the grain of azote which is also hourly exhaled, as well by the lungs or the skin as by the urine.

Thus the amylaceous matters are changed into gum and sugar; the saccharine matters are absorbed.

The fatty matters are divided, and converted into an emulsion, and thus pass into the vessels, in order to forms depôts which the blood takes back and burns as it needs.

The neutral azotated substances, fibrin, albumen, and caseum, which are at first dissolved, and then precipitated, pass into the chyle greatly divided, or dissolved anew.

The animal thus receives and assimilates, almost unaltered, the azotated neutral substances which it finds ready formed in the animals or plants upon which it feeds; it receives fatty matters, which come from the same sources; it receives amylaceous or saccharine matters, which are in the same predicament.

These three great orders of matters, whose origin always ascends to the plant, become divided into products capable of being assimilated, fibrin, albumen, caseum, fatty bodies which serve to renew or recruit the organs with the combustible products, sugar and fatty bodies which respiration consumes.

The animal therefore assimilates or destroys organic matters ready formed; it does not create them.

Digestion introduces into the blood organic matters ready formed; assimilation employs those which are azotated; respiration burns the others.

If animals do not possess any peculiar power for producing organic matters, have they at least that special and singular power which has been attributed to them, of producing heat without expenditure of matter?

You have seen, while discussing the experiments of MM. Dulong and Despretz, you have positively seen the contrary results from them. These skilful physicists supposed that an animal placed in a cold water calorimeter comes out of it with the same temperature that it had on entering it; a thing absolutely impossible, as is now well known. It is this cooling of the animal, of which they took no account, that expresses in their *tableaux* the excess of heat, attributed by them and by all physiologists, to a calorific power peculiar to the animal, and independent of respiration.

It is evident to me that all animal heat arises from respiration; that it is measured by the carbon and hydrogen burnt. In a word it is evident to me that the poetical comparison of a railroad locomotive to an animal, is founded on a more serious basis than has, perhaps, been supposed. In each, there are combustion, heat, motion; three phenomena connected and proportional.

You see that, thus considering it, the animal machine becomes much easier to understand; it is the intermediary between the vegetable kingdom and the air; it borrows all its aliments from the one, in order to give all its excretions to the other.

Shall I remind you how we viewed respiration, a phenomenon more complex than Laplace and Lavoisier had thought, or even Lagrange had supposed, but which, precisely as it becomes complicated, tends more and more to enter into the general laws of inanimate nature?

You have seen that the venous blood dissolves oxygen and disengages carbonic acid; that it becomes arterial without producing a trace of heat. It is not, then, in becoming arterial, that the blood produces heat.

But under the influence of the oxygen absorbed, the soluble matters of the blood change into lactic acid, as MM. Mitscherlich, Boutron-Charlard, and Fremy observed; the lactic acid is itself converted into lactate of soda; this latter, by a real combustion, into carbonate of soda, which a fresh portion of lactic acid decomposes in its turn. This slow and continued succession of phenomena which constitutes a real combustion, but decomposed at several times, in which we see one of the slow combustions to which M. Chevreul drew attention long ago, this is the true phenomena of respiration. The blood then becomes oxygenised in the lungs; it really breathes in the capillaries of all the other organs, there where the combustion of carbon and the production of heat principally take place.

A last reflection. To ascend to the summit of Mont Blanc, a man takes two days of twelve hours. During this time he burns at an average 300 grammes of carbon, or the equivalent of hydrogen. If a steam engine had been employed to take him there, it would have burnt from 1,000 to 1,200 to accomplish the same work.

Thus, viewed as a machine, borrowing all its power from the coal that it burns, man is an engine three or four times more perfect than the most perfect steam engine. Our engineers have, therefore, still much to do; and yet these numbers are quite such as to prove that there is a community of principles between the living engine and the other; for, if we allow for all the inevitable losses in steam engines which are so carefully avoided in the human machine, the identity of the principle of their respective powers appears manifest and clear.

But we have followed far enough considerations as to which your own reflections are already in advance of me, and where your recollections leave me nothing more to do.

To sum up, then, we see that of the primitive atmosphere of the earth, three great parts have been formed:

One which constitutes the actual atmospheric air; the second, which is represented by vegetables; the third, by animals.

Between these three masses, continual exchanges take place; matter descends from the air into plants, enters by this route into animals, and returns to the air according as these make use of it.

Green vegetables constitute the great laboratory of organic chemistry. It is they which, with carbon, hydrogen, azote, water and oxide of ammonium, slowly build up all the most complex organic matters.

They receive from the solar rays, under the form of heat or of chemical rays, the powers necessary for this work.

Animals assimilate, or absorb, the organic matters formed by plants. They change them by little and little; they destroy them. In their organs, new organic substances may come into existence, but they are always substances more simple, more akin to the elementary state, than those which they have received. By degrees these decompose the organic matters slowly created by plants; they bring them back,

little by little, towards the state of carbonic acid, water, azote, and ammonia, a state which allows them to be returned to the air.

In burning or destroying these organic matters, animals always produce heat, which, radiating from their bodies in space, goes to supply the place of that which vegetables had absorbed.

Thus all that air gives to plants, plants give up to animals, and animals restore to the air; an eternal circle, in which life keeps in motion and manifests itself, but in which matter merely changes place.

The brute matter of air, organized by slow degrees in plants, comes, then, to perform its part without change in animals, and serves as an instrument for thought; then, vanquised by this effort, and broken as it were, it returns brute matter to the great reservoir whence it came.

Allow me to add, in finishing this picture, which sums up opinions, which, to my mind, are but the necessary consequences and developments of the great path which Lavoisier marked out for modern chemistry; allow me, I say, to express myself as he did with regard to his fellow labourers and his friends.

If in my lessons, if in this summing up, I have chanced to adopt, without mentioning it, the experiments or the opinions of M. Boussingault, it is that the habit of communicating to each other our ideas, our observations, our manner of viewing things, has established between us a community of opinions, in which we ourselves, even afterwards, find it difficult to distinguish what belongs to each of us.

In resting these opinions and their consequences on his name and on his authority, in telling you that we work actively, sometimes together, and sometimes apart, in order to verify and to develope all these facts, all these results, by experiment, I do but evince my anxious desire to justify the interest which you have this year taken in my labours.

For this I beg to thank you. It has given me courage to undertake a long course of researches: if anything useful to the progress of humanity should result from them, let all the honour of it redound to the intelligent good-will with which you have constantly surrounded me, and for which I shall ever be profoundly grateful.

[From the American Journal of Science for October.*]

On the Evidence of a general Whirling Action in the Providence Tornado. By W. C. Redfield.

On the 30th of August, 1838, between the hours of 3 and 4 P. M., a violent whirlwind, or tornado, visited the town of Providence, in the State of Rhode Island. It was preceded by a shower of rain of short duration, after which the tornado appeared, appended to another cloud, and passed through the southern part of the town nearly from west to east.

Its earliest ravages reported, were in Johnston, at the farm of Mr. Randall, about seven miles west from Providence. From this point it passed on through Cranston and Providence, where, crossing the river into the State of Massachusetts, it passed through Seekonk, Re-

* Communicated by the Author for the Journal of the Franklin Institute.

hoboth, Swansey, Somerset, and as far, at least, as Freetown, beyond Taunton river; a distance of twenty-five miles from the point first mentioned.

The width of its visible track, as indicated by the prostration of trees, fences, and other objects, varied from a mere trace in its narrowest, to two hundred yards or upwards in its widest portions. Having, a few days after the occurrence of the tornado, carefully examined the track for the distance of about seven miles, on each side of Providence river, I propose to offer some of the results of this examination, together with such remarks as may seem justly deducible from the effects observed.

So far, however, as the impressions made on an accidental eye-witness of the tornado may be important, we have a valuable account furnished us in the letter of Zachariah Allen, Esq., of Providence, which is given in Dr. Hare's notice of this tornado. [Silliman's Journal, vol. xxxviii, p. 74–77.] Mr. Allen had the advantage of viewing its progress from a point near its path. He calls it a "whirlwind," and describes its phenomena in a manner perfectly consistent with this appellation. "The circle formed by the tornado" on the river, he describes as "about three hundred feet in diameter," and mentions, that the "misty vapors" . . . "entering the whirling vortex, at times veiled from sight the centre of the circle, and the lower extremity of the overhanging cone of dark vapor:" and that "amid all the agitation of the water and the air about it, this cone continued unbroken," &c.

This "cone" of the tornado of which he so often speaks, it should be noted was an *inverted* one, the smaller end of which was sweeping on the earth's surface.* Thus he gives the instance, "when the point of the dark cone of cloud passed over the prostrate wreck of the building, the fragments seemed to be upheaved," &c. It will be seen here that the *prostration* of the building had preceded the arrival of the centre or "point" of the "cone;" showing that the whirlwind often acts on a large area, with great force, *externally* to the lower part of the *visible* cone, or the column of vapor at its axis. Moreover, the substances which by the centre of the tornado were "uplifted high in the air," were "left to fall from the OUTER EDGE of the black conical cloud."†

Mr. Allen says further, "The progress of the tornado was nearly in

* We may properly conceive of this "cone," in tornadoes or water-spouts, as including not only the visible, clouded condensation here described, but also the invisible portion of the whirlwind which surrounds the narrow and depending portion of the visible cone, below the general line of condensation. Thus the *entire* body of the whirlwind is generally a truncated cone; its smaller and most active end sweeping along the surface of the earth or sea.

† Mr. Allen states that the form of the cloud and of the cone of vapor depending from it so nearly resembled the engraved pictures of "water-spouts" above the ocean, that he should have come speedily to the conclusion that one of these "water-spouts" was approaching, had he not been aware that "this phenomenon occupied a space in the heavens directly above a dry plain of land." Perhaps it might be inferred that Mr. A. had partaken of the too common notion, that the misnamed *water-spout* is, or should be, literally a *spout of water*. This phenomenon, so much talked of among mariners, proves to be nothing more nor less than the visible, inverted "tapering cone of vapor" or condensation, noticed by him as "extending from the cloud to the surface of the earth," *at the axis or ascending portion of the whirl;* if we may at all rely on the results of extensive examinations and comparisons of the accounts of "water-spouts" and their effects. The same appearance was observed in the New Brunswick

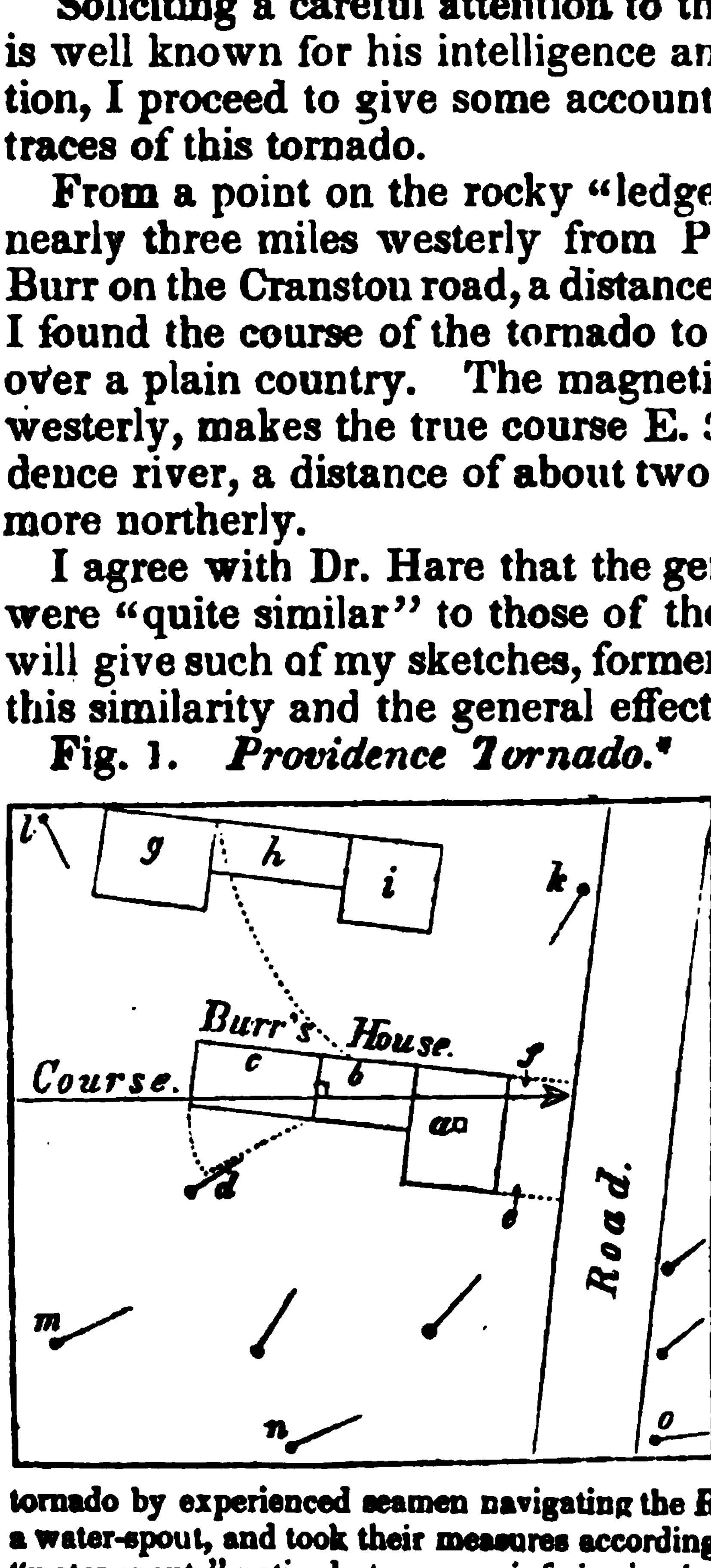
a straight line, following the direction of the wind, with a velocity of perhaps eight or ten miles per hour. Near as I was to the exterior edge of the circle of the tornado, I felt no extraordinary gust of wind; but noticed that the breeze continued to blow uninterruptedly from the same quarter from which it prevailed before the tornado occurred. I also particularly observed that there was no preceptible increase of temperature of the air adjacent to the edge of the whirlwind, which might have caused an ascending current by a rarefaction of a portion of the atmosphere."

Soliciting a careful attention to the observations of Mr. Allen, who is well known for his intelligence and his habits of correct observation, I proceed to give some account of my own examinations of the traces of this tornado.

From a point on the rocky "ledge" north of the turnpike road and nearly three miles westerly from Providence, to the house of John Burr on the Cranston road, a distance of about one and a quarter miles, I found the course of the tornado to have been S. 86° E. by compass, over a plain country. The magnetic variation being here about 8° westerly, makes the true course E. 3° N. From this point to Providence river, a distance of about two miles, the course was five degrees more northerly.

I agree with Dr. Hare that the general effects observed on this track were "quite similar" to those of the New Brunswick tornado; and will give such of my sketches, formerly prepared, as will best illustrate this similarity and the general effects here mentioned.

Fig. 1. *Providence Tornado.**



The annexed is a sketch [Fig. I,] of some of the effects on the farm of Mr. Burr: His house is about one mile and a half from the Providence bridge.

In this figure, *a* represents a wooden dwelling-house of two stories, with chimney at its centre: *b* a dwelling added to *a* and extending to the rear: *c* a lighter building about 16 feet by 30, attached to the rear of *b*: *g* was a large wooden barn: *h* a long building or shed extending from the barn to the carriage-house *i*. The width of the visible track

tornado by experienced seamen navigating the Raritan river, who at once pronounced it to be a water-spout, and took their measures accordingly. It is probable, however, that most of the "water-spouts" noticed at sea, are inferior in size and energy to these destructive tornadoes.

A "water-spout" was seen by Messrs. Tyerman and Bennet near Borabora in the Pacific, which extended nearly horizontally from one cloud to another directly over their heads; and no harm done! The most credulous will hardly conceive this to have been *a column of water*, or even approximately such; besides, no sea-water has ever been known to fall from the clouds. Similar "spouts" have been seen by others; and I once beheld a magnificent example of this kind, in one of the interior towns of Connecticut; which probably indicated an axis of rotation nearly horizontal.

* On these plans the large dot at the end of the several short lines, shows the original position of the root of the tree; the pointed end of the line shows the direction of its top.

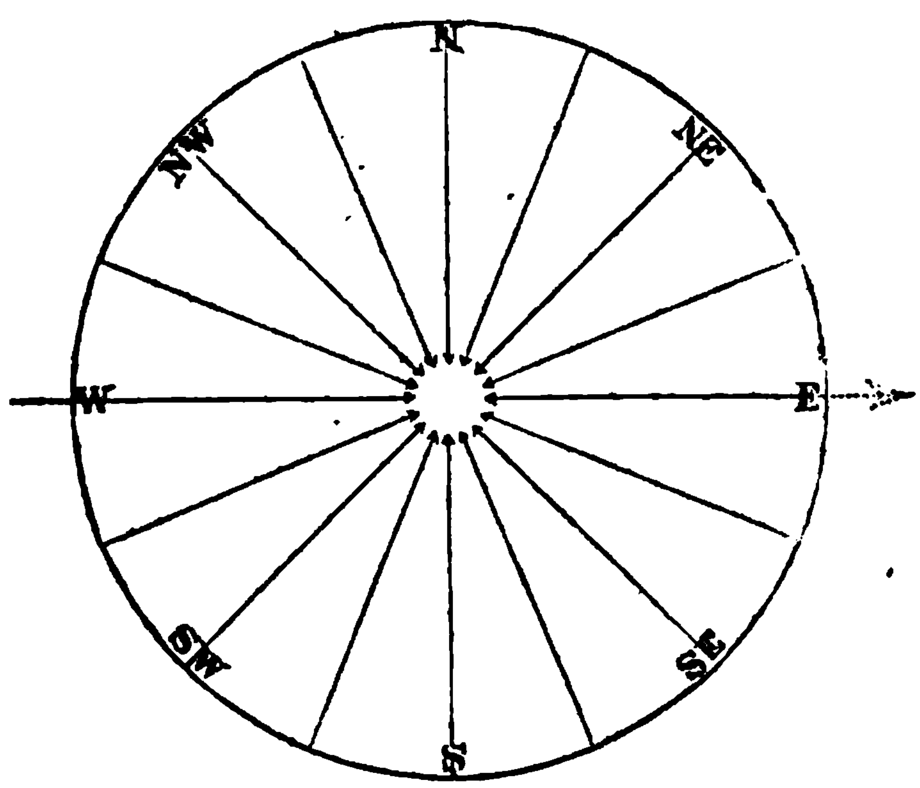
was here about five hundred feet, and the course of the centre or axis of the tornado appeared to have passed somewhat diagonally over the first three named buildings.

The house *a* withstood the shock, receiving some damage; the chimney top of *b* was thrown on the roof of *a*, perforating the same, while *b* was unroofed and greatly injured, and a long timber or *sill* from the shed *h* broke endwise into the upper part of the house *b* from a northwesterly direction. The building *c* was turned more than twenty feet to the *left about*, as regards the axis of the whirlwind, against the top of the prostrated pear tree *d*, and was there overturned upon it. There were twenty-one persons in *a* and *b*, including a school of children, none of whom were seriously injured.

The barn *g* and the shed *h* were destroyed, and the materials swept off toward the first named buildings. A corn-house, standing on the same side with the barn, is stated in the Providence papers to have blown over to the *west*, but I can find no notes of my own respecting the direction of its fall.

The effects here exhibited appear to me to be due to a progressive whirlwind, revolving to the left; for we may notice, as in the New Brunswick tornado, a more onward direction in the trees prostrated on the *right* of the axis, *d, m, n, o*, &c., than on the left side; while the outermost prostrations on the right, *n, o*, point still more nearly than the average on this side, to the course of the tornado: And on the left side of the track we have the tree *k* in a direction inclined several degrees *backward* from the course of the storm. The value of these indications of whirling action I have endeavoured to point out in my remarks on the New Brunswick case. [This Journal, vol. ii, 3rd series, 1841, p. 41–48.]

Fig. II.



At the front of the house *a*, however, were two slatted door-yard fences, extending from the house to the road. The fence *e* was overthrown northward towards *f*, and the fence *f* in the contrary direction towards *e*: both directions being *transverse* to the line of the axis, which passes between them. Such cases have been adduced as supporting a directly inward course of the wind in the body of the tornado; or, as indicating two bodies of opposing wind meeting on a central line; but I draw a different conclusion.

Let Fig. II represent, horizontally, the directions of such centre blowing winds in the body of the tornado, and let it be supposed as passing over the area of Fig I, without revolving, so as the course of the centre will coincide with the arrow which indicates the course of

the axis on that figure. It may thus be seen that on this hypothesis the wind must strike the fences *e, f*, either parallel to their length, or but little oblique; a direction of wind which seldom or never prostrates fences, even in the path of a tornado. Besides, *near the centre* of such an inward blowing tornado, where only it could act on these fences with *lateral* force, such winds must necessarily become neutralized both by blowing against each other and by turning upward to escape, thus having little effect at this point, within four feet of the ground. I say nothing here of the possibility of any winds blowing *with violence* in such central and opposing directions; which I could never conceive: for the entire spaces between the centripetal lines of arrows must be conceived as being filled by the affluent winds; the lines only indicating their directions.

But on the other hand, let us suppose a strong whirlwind passing in the same direction: the front half of which, both on and near the line pursued by its axis, must necessarily sweep laterally across this line, first *northwardly* towards *f*, if it be revolving to the left; and the last half of the whirl on its arrival will sweep *southwardly* towards *e*; which sufficiently accounts for the effects observed. That only the fence *e* was thus prostrated by the first wind of the tornado may be explained by the protection afforded to *f* by the house, against the *advancing* whirl, and perhaps here, also, by the spirally *upward* tendency towards the centre, in the wind which thus came round the southeast corner of the house, prostrating *e* in its course. But on the passing of the axis of the whirl, the wind would recur with increased force from the opposite direction, upon the fence *f*, prostrating it towards *e*; while the latter, being already down, and in turn partially protected by the house, would remain as it first fell.

In passing over the track of the tornado between Burr's house and Providence river, several instances and groups of prostration were observed. But owing to the open character of the grounds throughout most of the track, the memorials afforded by the trees were less frequent than have been seen in other cases.

Near the Pawtuxet turnpike, the tornado encountered a new house belonging to Mr. Gardner. This house was in the southern portion of the track *on the right of the axis*, and was removed and *turned* several feet *towards the left*.

It is proper to mention here that the *order of changes* in the wind's *direction*, viewing the tornado either as a whirlwind, or, as claimed by Mr. Espy and seen in Fig. II, would at any *fixed point* on this the right side of the track, be successively *towards the right*, as relates to the centre of the tornado. But this building having received its motion by yielding to the wind, shows the true course of the latter as whirling to the left.

Passing by the prostration of the range of buildings near the river, described by Mr. Allen, I proceed to notice the effects which appeared on crossing to the Massachusetts side.

From the bank of the river to the house of Abraham Tifts on the Lyon farm, three-fourths of a mile, the grounds were open and un-

broken, being mostly under cultivation and with few trees exposed to the tornado, excepting an orchard of scattered apple trees westward of Tifts' house. The traces of the wind in and adjacent to this orchard were very distinct in their character, and I subjoin here the sketch on which they are represented.

Fig. III. *Providence Tornado.*

North or left side.

South or right side.

Explanations of Fig. III.—The cases of prostration 4 to 14, were from a line of small locust trees on the west border of an old apple orchard, and are severally shifted a little out of line for the sake of a distinct exhibition of their directions.

From thence to near Tifts' house at *b*, the ground is but slightly foreshortened, and the relative positions of each tree, on the left of the centre, is approximately shown. The figure was drawn from my field notes on account of the distinct phenomena which were exhibited on this part of the track, and which, in cases *a*, 14, 22, 21, 23, and 27, show conclusively the first action of the whirl *across the path of the axis*, and sweeping towards the northern border of the track. On the opposite or right side of the axis, southward of 15, there were no trees exposed, and the effects of the tornado were here visible only on the crops and fences. Therefore the cases shown on the figure south of the axis, and also westward of 22 on the left hand side, were brought in from the more western parts of the track between the orchard and the river, and include all the prostrations from the latter to Tifts' house;

and their relative distances from the axis or centre of the track are but approximated.

Case 14, represents a small locust tree broken off at an old wound near the root and carried *outward and backward* into the adjoining fallow field, having struck into the ground several times in its course, leaving distinct traces. It was finally left at a point N. 57° W. from its stump, at the distance of forty yards, with its top turned southwardly, in conformity with its two last traces in the soft ground.

Case 10, a small locust tree was prostrated S. 25° W., leaving its mark in the fallow ground. It was subsequently shifted, by the progressive change in the whirlwind, to S. 11° E.

Case *a*, an old apple tree with but a single branch projecting southwardly from its trunk: This branch was taken off by the onset of the tornado, and struck into the ground northwest from the trunk, depositing its apples at this spot. The limb itself was missing.—Case 21, apples deposited as in case *a*.

Case 22, a small wild cherry tree, was found lying on and against the stump of 14, having first been thrown *from the latter* by the onset of the wind and subsequently swung round by the south to its present position, as appeared by the impressions made in the ground. Its final position was such, as if occurring at the outset would have prevented 14 from being carried off northwesterly.—Case 23, the branch of an apple tree was thrown west.—At *b* is shown the relative position of Tifts' house.

Case 27, shows the original position of a large pear tree, the stem of which was broken off and first thrown northward, where it ploughed up the soft ground of the garden by its force, and continued its circuit to a point northwest of its original position, where it remained with its top turned toward the south.

For the purposes of a general comparison, the observed or first known directions of the prostrations on the two sides of the track may be summed up as follows.

Left or North side of the Track.			*Right or South side of the Track.*		
Case.	Direction of first prostration.	Inclination inward and backward from course of tornado.	Case.	Direction of first prostration.	Inclination inward and backward from course of tornado.
38	S. 74° E.	16 degr's.	29	N. 65° E.	25 degr's.
39	S. 70 E.	20	32	N. 77 E.	13
35	S. 67 E.	23	30	N. 60 E.	30
1	S. 10 E.	80	33	N. 80 E.	10
2	S. 23 E.	67	34	N. 88 E.	2
3	S. 45 E.	45	36	East,	0
4	S. 12 E.	78	40	N. 65 E.	25
5	S. 35 W. (backw'd)	125	28	N. 63 E.	27
6	S. 5 E.	85	31	N. 75 E.	15
7	S. 40 E.	50	44	N. 63 E.	27
8	S. 11 E.	79	37	N. 87 E.	13
9	S. 10 E.	80	43	N. 30 E.	60
10	fell S. 25W. turned to S. 11 E.	115	41	S. 85 E.	5
			42	East,	0

Case.	Direction of first prostration.	Inclination inward and backward from course of tornado.
11	S. 26° E.	64 degr's.
12	S. 55 E.	35
13	S. 55 E.	35
14	first thrown N. 23 W. (backward)	247
15	S. 45 E.	45
16	S. 30 E.	60
17	S. 55 E.	35
18	East,	0
19	S. 85 E.	5
20	S. 27 E.	63
21	N. 55 W. (backw'd)	215
22	first fell N. W. turned to S. 37 E.	225
a	N. 45 W. (backw'd)	225
23	Branch of apple tree thown west	183
24	S. 20 W. (backw'd)	110
25	S. 55 W. (backw'd)	145
26	South,	90
27	first thrown N. 10 W.	260

Mean direction of prostration on the right side of the track N. 73° E.: average inclination inward from course of tornado, *seventeen degrees.*

Mean direction of first prostrations on the *left side* of track, S. 4° W.: average inclination inward and backward from course of tornado, *ninety-four degrees.*

Relative inclinations of the two sides to the line of axis, more than *five* to *one.*

It is proper to mention, that the average inward inclination of *all* the prostrations on the *right* side of the track for a distance of four miles east of the river was thirty degrees.* This, however, does not affect the conclusions in favor of rotation to the left.

These average results, on the two sides, together with the several particular observations already adduced, appear to me to afford decisive evidence of whirlwind rotation in this tornado, in the direction from right to left or which is contrary to the hands of a watch. In reference to this evidence and that exhibited in my paper on the New Brunswick tornado, I add from my prepared sketches the following figure, as an approximate illustration of the whirling action in these tornadoes, so far as this may be shown *horizontally* and by a stationary figure.

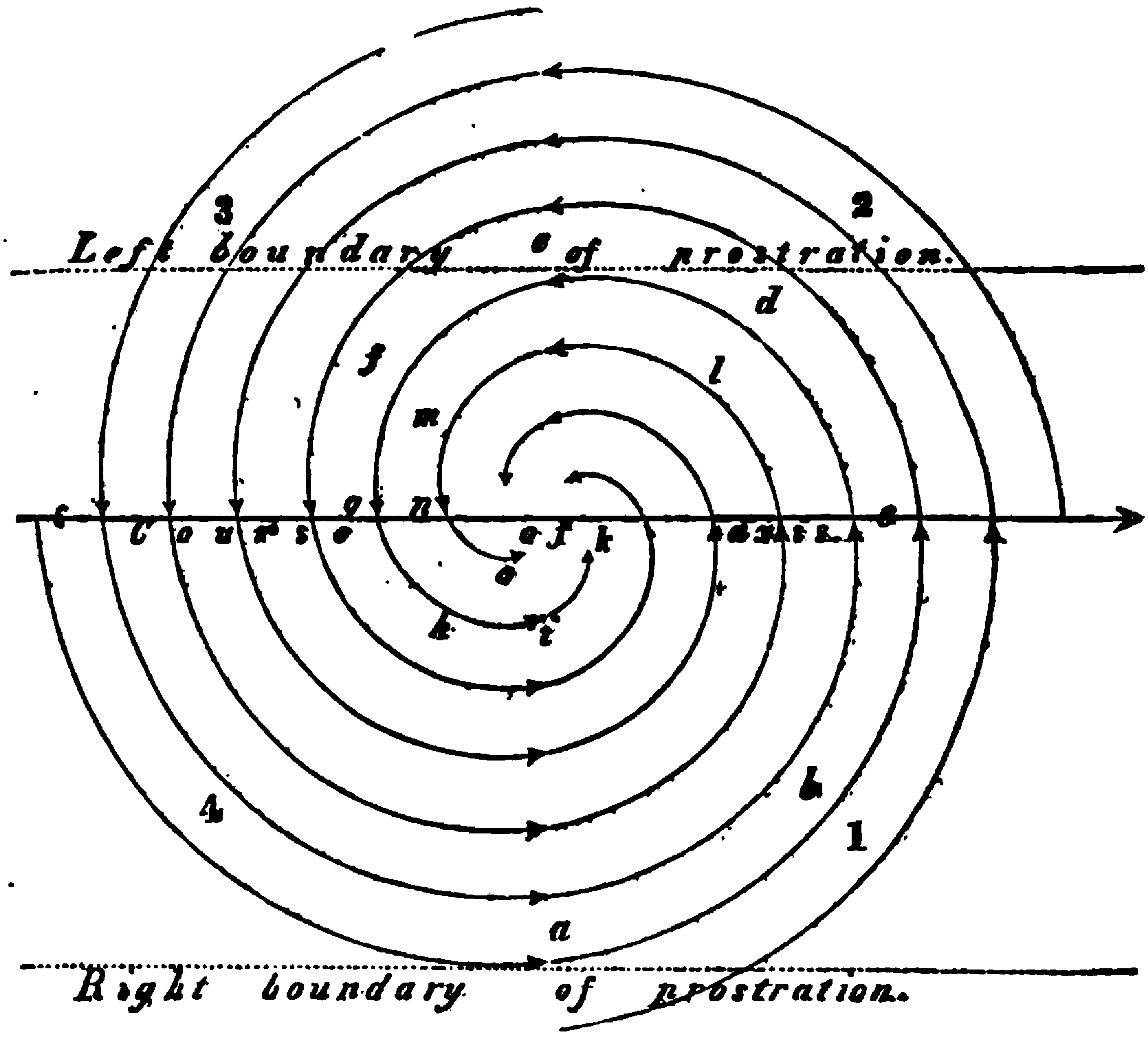
Let the involuted lines or arrows on figure IV be supposed to represent the motion of the wind at or near the bottom of a vertically cylindrical portion of the centre of a tornado, comprising a length of radius equal to the greatest width of the prostrating power on the right of the axis of its path. Now if the tornado be considered as whirling in the manner here represented, but *without any change of location,* its action may be supposed as concentrically equal on all sides; the motion, however, becoming quickened towards the centre in the *inverse ratio* of the successive concentric areas: that is, each particle of air as it revolves about the axis, *continuing to describe nearly equal areas in equal times,* in its progress towards the centre, where it rises spirally in the direction of discharge; this direction being vertically at the centre, the point or area of least atmospheric resistance or pressure. Thus, the course of a single particle, horizontally, may be *a b*

* This larger average gives a relative degree of inclination on the two sides of *three* to *one.* Nearly the same difference is found in two outside bands of prostration, of equal widths, (Tables I and V,) shown in my survey of the New Brunswick Tornado. See this Journal, vol. ii, 3rd series, 1841, p. 44.

c d e f g h i k;—and so on or between each of the four involuted lines which constitute the figure.

For further reference, we may divide this figure by the cross lines of arrow heads, into the four quadrants 1, 2, 3, 4.

Fig. IV.



We will now consider this whirl as having *a constant progressive motion* on the line of the long arrow *c c*, at a rate equal to one-fourth or fifth of its average rotative velocity. It will then follow, that as the force of the whirl on the trees and other objects encountered by it, is *as the square of the wind's velocity* at the point of impingement, the relative effects on the two sides of the line of the axis, which before were equal, will now be greatly altered.

For, if at a given distance *on the right* of the advancing axis, the former velocity was 80, it will now, as relates to the earth's surface, have become 100; and at the same distance on the *left* side the velocity of the wind will be reduced to 60, as relates to the earth's surface. Thus the squares of these effective velocities will give a power relatively equal to 100 at the former point and only 36 at the latter; both being equally distant from the axis. Hence, although the *rotative* velocity of the whirl decreases rapidly as we recede from its axis, yet its *prostrating* power will, by its progressive motion, become greatly extended on the *right* side of the advancing axis, and proportionally contracted on the left side. Thus the respective boundaries of the prostrating power on the two sides of the tornado, when thus in mo-

tion, may be those indicated on the figure; which nearly correspond to the effects which have been observed in several cases.

It may be seen further, that *nearly all the prostrations* near the line of the axis and elsewhere, must by the advancing motion of the tornado, receive a direction *more onward* than is represented by the arrows or lines in the figure, which can represent only a stationary rotation.

In further considering these effects, in different portions of the whirl, as it encounters objects in its advance, we shall find the maximum effects to be mainly on the line *a, i, o*, at the rear of the *first quadrant*. Hence, if a tree on this side the axis should fail to be prostrated till after the first quadrant had passed over, it would not be likely to fall in the fourth quadrant, on the further advance of the tornado, unless very near to its axis. Moreover, if one tree should fall when under the more advanced portion of the first quadrant, another if prostrated later in the same quadrant, must necessarily fall in a *more onward* direction than the first, and if sufficiently near will lie across the latter.

It may likewise be seen, that the wind of the whirl in passing into the *second quadrant*, on the left side of the track, is sweeping *backward*, and with its effective power thus greatly reduced, as regards fixed objects on the earth's surface. Thus the limits of prostration are not only narrowed, but the effective power is here greatly reduced, and gives *fewer prostrations* than under either the first or third quadrants. The *minimum* of effect occurs on the arrival of the line *e k*, at the rear of the second quadrant.

But on the arrival of the *third quadrant*, the prostrating power on the left side becomes more and more efficient by the ceasing of the backward and the accession of the progressive movement; and at or near the line of *f m*, it again takes effect, with rapid increase. The destructive force is also much augmented here by the greater velocity in the heart of the whirl, near its axis, and the impetus must rapidly incease in energy to its maximum effect, as at *m n o*, taking off any tree which may here remain, and carrying aloft, or sweeping onward, the objects previously prostrated on the line *c x k*.

If a tree on the *left* side of the track falls on one previously thrown down by the tornado, the last fallen will also have the more onward direction, as on the other side: unless both have fallen in the second quadrant, where few prostrations occur. The *fourth quadrant*, for causes noticed in considering the *first*, can have little prostrating effect; except perhaps on the small area near its axis.

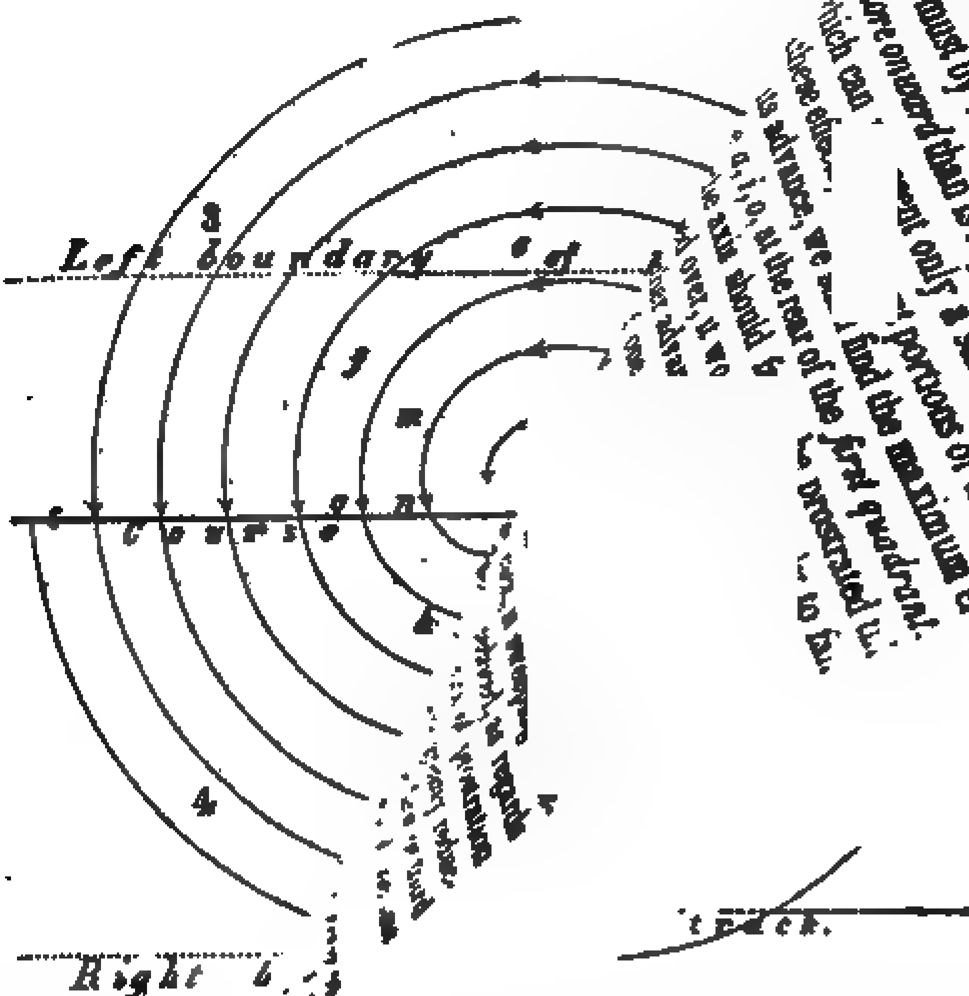
If we now conceive of our figure as applied only to the limits of prostration or destruction which constitute the *visible path* of the tornado, it becomes apparently and relatively unequal, in its right and left hand quadrants, the axis appearing greatly eccentric, and in the same degree, at least, as the *left* band or belt of prostrations is found narrower than that on the right of the axis. This apparent, but illusive form of the whirl, may be illustrated by Fig. V, which is drawn on the same lines with the preceding figure.

It will readily be seen that this eccentricity of the axis, on the visible track, will be in proportion to *the progressive velocity of the tornado;* other things being equal. Thus, if Mr. Allen be nearly right

c d e f g h i k;—and so on or between each of the four invol[...]
which constitute the figure.

For further reference, we may divide this figure by [...]
of arrow heads, into the four quadrants 1, 2, 3, 4.

Fig. IV.



We will now
motion on the
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force of the v
as the squa
relative eff

..ppears to result, that an observer who
..nado after its departure, will find on one
..s of its path, *if it be a whirlwind*, a continu-
..ons pointing almost invariably onward and in-
..s degrees of inclination to the course of the path.
..her side of the axis, a narrower band or belt of pros-
..be found, which are also inclined mainly inward and on-
..showing greater inclinations from the line of progress, to-
..frequent cases which incline more or less backward and
..en outward from the course of the tornado.

..o appear, that a want of proper attention to the necessary
.. the prostrating power in a progressive whirlwind, can
..us to ascribe such effects to supposed antagonistic winds
..ltaneously in opposing directions.

..or a moment, the more tangible features of this inquiry,
.. take some notice of the more outward portions of the
..hirlwind, which are supposed not to be comprised in
..suming here the involuted and inward motion, with its
..harge at the centre, it follows that the impulsive accession
..is necessary for maintaining a violent whirlwind action,
.. horizontally, and in the same gradually involuted course;

...nd in like manner from a higher region, in and around ...ts of the whirling cone. I have long since been led ...impulsive accession comes from *both* these sources, ...*atter;* and that this motion of accession and sup...*d* in the outward portions of the whirl. The ...ortions, often greatly expanded, as noticed

...pinion rests, can be but partially al... following considerations:—1. The ... unusually cold air in the higher ...ays remarkable for the occur...nadoes.* 2. The observed ... the nucleus or body of a ...es be traced by the eye ...fford opportunity for ...nd others, that ad...'' or whirlwind, ...erruptedly from ...when taken also in ... effects in the outward ...ge of which I have gather...ness of the air which has been ... 6. The instant penetration of the ... thick forests, and into hollows and ...quently noticed. 7. The direct memorials ...e outward portions of the whirl, which I have ...ne tracks of different tornadoes.

...foregoing remarks it has been my design to view the ...oves onward, in full action. Of the origin or incipient ...e whirl, it is not necessary here to inquire; although some ...nese is perhaps afforded us in the considerations above noticed.

...curring once more to the track of the Providence tornado, I have ... state that eastward of Tifts' house the course of the track soon became S. 65° E. magnetic, for more than two miles. It then took the course of S. 75° E., and further onward the tornado passed directly over the house of Solomon Peck, about four miles from Providence. This house was partly unroofed; chimney thrown down; windows broken *inward,* as in many other cases; and much other damage was also done to Mr. Peck's property. In passing onward towards Taunton river the tornado appears to have preserved an inclination to the south of east: the track, though slightly sinuous, appearing, like that

* This change of upper temperature I think can be clearly made out on the day of the New Brunswick tornado, which was but one of many tornadoes and thunder gusts which appeared in this part of the United States on the same day; and on the preceding day in Illinois and other western states.

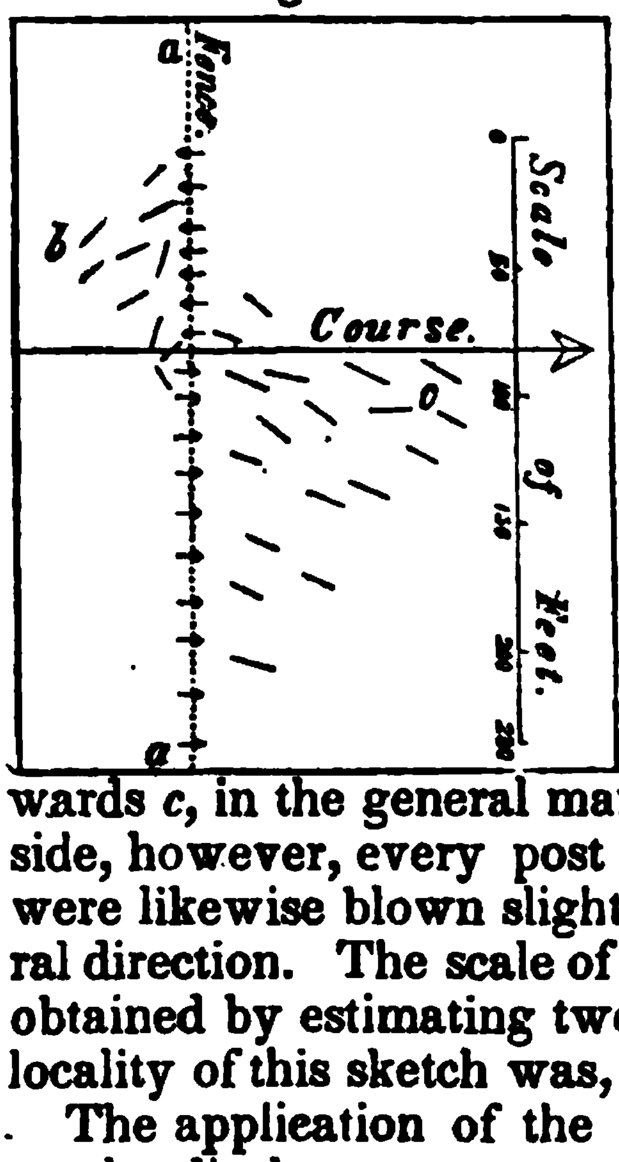
In the New Haven Gazette are accounts of *five* severe tornadoes which occurred in the states of New Jersey, Connecticut, Massachusetts and Rhode Island, on the afternoon of August 15, 1787. I can also refer to many more recent cases of this kind.

† The observation here quoted is one of many which show the error of the very hasty generalization which alleges a circuit or annulus of calm air to have been observed *on all sides* of tornadoes and hurricanes.

of the New Brunswick tornado, to form part of a great curve, with its convex side to the northward.

On the track from the Lyon farm to Peck's house there were many interesting memorials which might confirm the deductions already made. On some portions of the track, also, the tornado appeared to have risen almost entirely from the surface, its reverse apex leaving but a narrow trace, and on some fields, even no trace at all. But in these cases, as on the tracks of other tornadoes, the compass bearing did not fail to lead the explorer to new ravages, where, at times, the energy of the tornado appeared to be greater than before.*

Fig. VI.



Before we take leave of the traces of this tornado I would adduce another of my prepared sketches, which shows the rotative effects in a manner which I think should satisfy the most strenuous opposer of whirlwind action. In this sketch, Fig. VI, we have represented a portion of the track which crossed at right angles a line of weak post-and-rail fence, *a*, *a*. On the *right* of the axis, this fence was prostrated *eastwardly* or in the direction of the course of the tornado, as shown by the short arrows which may represent the posts of the fence; the rails also having been scattered onward and inward, towards *c*, in the general manner represented in the figure. On the *left* side, however, every post was prostrated *westwardly*, and the rails were likewise blown slightly backward toward *b*, in the same general direction. The scale of feet, which measures across the track, was obtained by estimating twelve feet to each length of the rails. The locality of this sketch was, perhaps, a mile eastward of the Lyon farm.

The application of the foregoing views of rotation to this case, it can hardly be necessary to point out.

I have noticed many effects of similar kind on fences; but that the *backward* prostration on the left side of the track should have taken full effect in this case, and mainly, perhaps, under the second quadrant, I ascribe to the age and general weakness of the fence.

Additional memorials might here be adduced in evidence, and of similar character to the foregoing; but having already occupied more space than I intended, I must now leave the question of a general whirlwind rotation in this and other tornadoes to the candid consideration of impartial inquirers.

New York, July 12, 1842.

* This is not uncommon in tornadoes, and is especially noticed in the account of two "Trombes" which are given in Pouillet, Elemens de Physique et de Météorologie, § 655.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in the Process of *Distilling;* Samuel Oliver, Northampton county, Pennsylvania, August 4.

This improvement, the patentee says, "consists in the introduction of wood ashes, lye, or potash, or either of them, into combination with the rye, corn, or other grain, after it has been mashed, and before the process of fermentation commences, and mixing it with the same in the proper proportions."

Claim.—"What I claim as my invention, discovery and improvement, and desire to secure by letters patent is, the application of wood ashes, lye, or potash, to the process of distillation of rye, corn, or other grain into whiskey, or alcohol, for the purpose of retarding the acetous fermentation and increasing the yield, using the specified quantities, or increasing or diminishing them as circumstances may require."

2. For an improvement in the Handles or Tholes of *Scythe Snaths;* Selah W. Fox and Arestes Terry, Bernardstown, Franklin county, Massachusetts, August 4.

Claim.—"We claim as our invention, constructing the clamp ring of the tholes with a spring washer on the interior of the same, and combining the said clamp ring with a shank firmly fixed in the handles, and having a male screw at one end which engages with a corresponding female screw in the lower and conical shaped part of the clamp ring, the whole being constructed and operating together in the manner described and for the purpose of firmly confining the handle to the snath. We also claim forming the shank which is inserted in the wooden handle, with a shoulder, by means of which the shoulder operates to press the collar against the snath, and draws the clamp ring down upon the opposite side of the same, independent of the wooden part of the handle, the whole being for the purpose specified."

3. For an improvement in the Process of *Hardening Steel;* Perry Davis, Fall River, Bristol county, Massachusetts, August 4.

The method of hardening steel as practiced by the patentee is as follows. "Instead of plunging the steel to be hardened into cold water, as is usual, it is plunged into a composition of borax, oil, and charcoal, to harden it, which mode of hardening renders the metal malleable with the same degree of hardness that was obtained by the old method; so that the metal, after being hardened in this way can be straightened or bent without any danger of being broken."

Claim.—"What I claim as my invention and which I desire to secure by letters patent is the mode of hardening steel so as to render it flexible by means of the composition of oil, charcoal, and borax, as set forth."

What influence the above described mixture can exert upon the part to be hardened, we are at a loss to perceive, and apprehend that the method frequently practiced of using oil alone, would have the same effect with the compound above indicated. We have been in the habit of hardening steel, and know of many devices which have been resorted to for the purpose of communicating toughness, but believe them all to be founded in error. The less rapid the cooling, the less will be the hardness, and, of course, the greater the toughness of the article operated upon.

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4. For an improvement in *Propelling Boats;* Meredith Mallary. Urbanna, Steuben county, New York, August 4.

There is to be a common water wheel, such as is used for driving mills, on each side of the vessel, or boat, immediately in the rear of the ordinary paddle wheel, and the shafts of the two sets of wheels are to be geared together; the water which is thrown up by the common paddle wheels is to fall into the buckets of the water wheels, and is there to lend its aid in the business of propelling.

Claim.—"Now what I claim as my invention is the applying the water lifted or thrown up by the paddle wheels of steam boats so as to produce an auxiliary propelling power, in the manner described, or in any way analogous thereto."

That these auxiliary wheels will exert some influence we have no doubt, but we are much mistaken if they do not prove to belong to the class of consumers only, and that of the worst kind, as they will not pay for what they devour.

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5. For an Ornamental *Covering for Stove Pipe Flues;* Perry Davis. Fall River, Bristol county, Massachusetts, August 4.

A plate is to be attached to a wall, where a stove pipe is to be inserted, with a hole in it to receive the end of such pipe, and a thin plate moving in suitable grooves, is to slide over and cover the hole, for the stove pipe, during summer when the stove is taken down.

Claim.—"I do not claim as my invention the construction of a plate with an aperture for stove pipes, having a slide to cover said aperture; but what I do claim as my invention and which I desire to secure by letters patent is constructing the perforated plate with a collar around the aperture to adapt it to the hole made by the stove pipe, in combination with the slide covering said aperture, as set forth."

In the whole catalogue of things patented we recollect but few so little worthy of the broad seal as the foregoing, and we are truly at a loss to perceive by what kind of logic it can be made to appear that a sliding cover to a stove pipe hole is a new and useful invention. There must have been some singular oversight, or obliquity of vision,

when a patent was ordered to issue for such a common and valueless device.

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6. For improvements in the *Condenser and Apparatus for Supplying Steam Boilers;* Joseph Echols, Columbus, Muscogee county, Georgia, August 11.

The apparatus, as described, for supplying boilers, consists of a receptacle, communicating with a cistern and with the boiler, by means of pipes governed by a four way cock which alternately forms a connection with the cistern, from which to receive the water, and then with the boiler to supply it with the water, thus received. The pipes forming these connections are narrow and high, and the one leading to the boiler has an inclination towards, and opens into, it, above the water line. Thus, when the communication between the boiler and receptacle is open, the steam from the former passes into the latter, and from this the water runs down the lower inclined surface of the tube into the former. The cock being then turned, cuts off this communication and opens it with the reservoir, which allows the water to run into the receptacle and condense the steam by which the water was expelled in the previous part of the operation. For low pressure engines, it is said that the top of the reservoir must be closed and a connection formed between it and the condenser.

The condenser is divided into two compartments, separated by a diaphragm pierced with small holes, and this forms a connection with a cistern of cold water by means of a fourway cock and receptacle such as are employed in the apparatus for supplying water, and operates in the same manner. The condenser is also connected with the cylinder of the engine, and is provided with an aperture and valve for the discharge of air and water. The water after passing from the cistern into the receptacle escapes into the upper division of the condenser, and percolating through the perforations in the diaphragm, condenses the steam. The air is forced from the condenser into the receptacle by the entering water, and in the same manner from the receptacle into the cistern.

Claim.—"What I claim and desire to secure by letters patent is, first, the manner in which I have combined and arranged the said cistern, receptacle, the said four-way cock, and the boiler, with said respective water passages, so as to effect the object of dispensing with force pumps (now in use for supplying boilers) and of giving a regular supply of water to the boiler, and of maintaining it at the same and desired height at all times, as above set forth. I do not claim the use of a four-way cock (except so far as using the plug of the same with only one passage through it) or of any of the respective parts of this apparatus taken individually, but I do claim them collectively in the particular combination described, not intending by this claim to limit myself to the exact form and manner of constructing the respective parts aforesaid, but to vary them as I may find expedient while they remain substantially the same, as herein before set forth. Secondly, I claim the manner in which I have combined and arranged the fore-

going described apparatus for condensing steam and for discharging a portion of the air liberated therefrom without the employment of an air pump. That is to say, I claim the manner in which I have combined and arranged the cold water cistern, the steam receiver or condenser, the receptacle and the four-way cock, so as effect the condensation of steam and of discharging a portion, at least, and in some situations nearly all, the air from said receiver or condenser through the said receptacle and cock substantially as herein described."

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7. For an improvement in the manner of constructing *Furnaces for Warming Apartments,* and for Cooking; William A. Shepherd, Waterville, Kennebec county, Maine, August 11.

Claim.—"What I claim as my invention is the manner set forth of arranging an air heating and cooking apparatus, by surrounding the interior of an air heating stove, by ranges of tubes, within which the air is to be heated, and thence conveyed so as to pass around an oven, or other cooking instrument, and subsequently into any apartment where heated air is required." The particular arrangement of this apparatus could not readily be made known without a drawing, and this we do not think it worth while to give.

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8. For an improvement in *Cabooses or Cooking Stoves;* Loftis Wood, New York city, August 11.

In this stove there are two ovens, between and towards the upper part of which is the fire chamber, with an ash pit below. The grate bars below the fire are made hollow and open into each of the ovens, the side plate of each oven, towards the fire chamber, being pierced to receive each grate bar. The bars are pierced with holes on their under sides to receive air from the ash pit, which passes through them, and enters the ovens highly heated.

The bottom plates of the ovens are made to lift out, to give free admission to the flues beneath them. There is above this bottom plate a sliding, or false, bottom, which is usually made of open work, and has a rack on the underside into which a pinion works, for the purpose of sliding this false bottom in and out, together with the articles upon it which are to be baked.

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the manner of combining the two ovens, the fire chamber between them, and the hollow grate bars, through each of which a current of heated air is admitted into each of the ovens, in the manner described. I also claim the false, or sliding, oven bottoms, having racks on their lower sides into which pinions mash, by which said bottoms are to be moved in and out by a combination and arrangement of parts, as set forth."

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9. For an improvement in the *Wind Mill;* Perry Davis, Fall River, Bristol county, Massachusetts, August 11.

This patent is taken for a modification of the ordinary vertical wind

mill, with inclined sails, or vanes. The shaft of the wind wheel has its bearings in the upper part of a tower, which rests, and turns, on a circular railway, and on a hollow shaft attached to the main framing. A solid shaft passes through the hollow shaft of the tower and is made to revolve by a crown wheel on the shaft of the wind wheel; and from its lower end motion is communicated to any kind of machinery to be driven. The lower inner edge of the tower is provided with cogs into which the teeth of a pinion, on the end of a vertical shaft, take for the purpose of turning it. This last mentioned shaft is connected with a centrifugal regulator, or governor, the balls of which are operated on by a sliding clutch that clutches either of two bevel pinions on its shaft so that when the mill runs too fast the balls are thrown out so far as to clutch the upper wheel, and thus to turn the tower, and the wind wheel, from the wind; and when it runs too slowly, the balls fall, and clutch the lower wheel which turns the wind wheel to the wind.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent is, the manner in which the movable tower is combined with the hollow stationary shaft, and main shaft of the machine, by making the hollow shaft stationary upon the frame as set forth, and causing the tower to revolve upon it, and combining the main shaft with the above arrangement by passing it through the hollow shaft in the manner described."

The second section of the claim is omitted, as it refers to, and would not be understood, without the drawings; it is, however, confined to the mode of regulating the position of the wheel in relation to the wind by means of the slide and clutch attached to the arms of the regulator, and clutching alternately the upper and lower wheels in combination with the cog rim on the tower.

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10. For an improvement in the *Cooking Stove;* Samuel L. Chase, Woodstock, Windsor county, Vermont, August 11.

The patent of which this is a reissue, was granted on the 25th of September, 1840, and is noticed in vol. ii of the third series of this Journal, page 345, to which the reader is referred for an explanation of its general characteristics. By comparing the following claim of the amended specification with the original, the reader will perceive the emendations which have been made in the patent.

Claim.—"Having thus fully described the nature of my improvement, and shown how the same is carried into operation, and having in so doing shown and described many parts and devices, of which I do not claim to be the inventor, I now proceed to state what I do claim, and desire to secure by letters patent, viz., first, the manner in which I have combined and arranged the flues, including the rarefier, as set forth, that is to say, the admitting the heated air from the fire chamber into the flue between the upper and the lower ovens; conducting it thence through the flue at one end of the flue under the lower oven, thence into the rarefying flue under the fire chamber, and thence into the exit pipe, all substantially as herein made known, and represented. Secondly, I claim, in combination, the arrangement

of the respective parts of the hearth for broiling, and other cooking operations, which arrangement consists of the sunken hearth, furnished with the bars and openings for the admission of air, the swinging hearth, and the flue formed by the notch in said hearth, and the sloping projection at the lower edge of the furnace door, or on the swinging hearth. I also claim the swinging hearth in combination with the sunken hearth, whether the said swinging hearth be made in one or in two parts, such swinging hearth constituting, when closed, the top or cover of the sunk hearth, and being provided with boiler holes and otherwise constructed and arranged as set forth."

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11. For improvements in the *Cooking Stove* invented by Samuel L. Chase, Woodstock, Windsor county, Vermont, August 11.

This patent is for improvements in the stove noticed in the foregoing article, and, in the improved form, the sunk hearth, which is covered by the swinging hearth, is provided with grate bars near the bottom and the whole space is divided into two compartments by a partition, above and below the grate. A small draught hole is provided at each end. There are two ovens in this stove, one above the other, and back of the fire chamber, the flues passing over, under, and up the ends of each. There is one draught hole that enters from the fire chamber into the flue under the bottom of the lower oven, the draught dividing and passing up the two side flues, and over the top oven to the exit pipe, and three other draught holes that enter from the upper part of the fire chamber into the flue between the two ovens, the two outside ones opening partly into the vertical side flues, and being provided with dampers to regulate the draught.

Claim.—"What I claim is, first, the dividing the sunken hearth into two compartments, below the grate bars, in combination with a stove having a swinging hearth, and a draught space below the projections on said swinging hearth, in the manner and for the purpose described. I also claim the manner in which I have arranged and combined the flues, and the four spaces, or openings, leading into them from the fire chamber; the whole being constructed, governed, and operating as set forth."

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12. For a Locomotive *Battery for Harbor Defence*; Prosper Martin, Philadelphia, Pennsylvania, August 11.

The patentee proposes to make use of common steamboats in time of war for the defence of harbors, &c., by surrounding them with double or single floating batteries which are to form a hollow square. These batteries are to consist of two parts, which may be separated to receive the boat, or boats, and are then to be brought together and made fast.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the conversion of our common steamboats into locomotive batteries, for the protection of our harbors, cities, villages, &c., by securing the steamboats, in part or in whole, in an encasement,

single or double, sufficient to protect them from injury, in manner substantially as herein described."

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13. For an improvement in *Stoves;* Thomas M. Jones, Boston, Massachusetts, now residing near Birmingham, England, August 11.

The improved stove is represented as being made cylindrical, and having a cylindrical case, or cap, surrounding and revolving on it, and resting on a ledge or flanch projecting all around the body of the stove at any height below the fire chamber. Instead of a door for supplying the fuel, a hole of sufficient size is cut in the body, or cylinder, of the stove, and through the outer casing, so that by revolving one on the other the opening in the body of the stove may be opened or closed at pleasure.

Claim.—"What I claim as my invention is a stove without doors having an internal vessel with a lateral opening for the admission of fuel connected with a movable or revolving external case that covers the whole, or any required portion, of the internal vessel—which external case has a lateral aperture corresponding to that of the inner vessel and is so adjustable that as it revolves more or less it may shut off either the whole, or none, or any part, of the lateral opening of the internal vessel."

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14. For a method of *Attaching Buttons to Garments;* Henry S. Poole, Boston, Massachusetts, August 11.

In the first place a metallic eyelet is made fast to the cloth in the usual way, and the button, which is made with a hollow cylindrical metallic shank, is rivetted on to the eyelet by means of a punch.

Claim.—"I claim as my improvement and ask a patent for the mode of fastening the button to the cloth by means of a metallic rivet attached to the shank of the button and fastened on a metallic, or other, eyelet, as set forth."

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15. For an improvement in the *Smut Machine* for Cleaning Grain; Jonas Nolt, West Hempfield township, Lancaster county, Pennsylvania, August 11.

The grain to be cleaned is to fall from the hopper into a shoe from which it is discharged on to a fall board, that is suspended by straps in an inclined position, its lowermost part being one of its corners; and the corner nearest the opening of the shoe where the grain is discharged on to it, being the next highest. The wind board of the fan, which is of the usual construction, directs the wind at an inclination downwards, so as to impinge upon the fall board a little within the lowest edge, the design of which is that as the heavy grains of wheat are rolling towards the lowest corner, the light smut balls may be blown off over the upper edge of the board. The shoe and the fall board receive a shaking motion in the usual manner of shaking the shoe of winnowing mills.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the manner in which the fall board, the hopper, the shoe, and the board for directing the current of air upon the grain are combined together—that is to say, the arranging the hopper and shoe over the lower end of the wind board, and inclining the fall board on its inner side and one end so as to allow the grain to cross the current of air, the whole being constructed and operating substantially as set forth."

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16. For an improvement in the machine for *Cleaning Rice;* Daniel H. Southworth, Little Falls, Herkimer county, New York, Aug. 12.

A patent was granted to Mr. Southworth on the 23rd of August, 1838, for a rice cleaning machine, and is noticed in vol. xxiv of this journal, second series, page 93, to which patent the present improvement is added.

In the original machine, at the upper end of the revolving beaters there was a cast iron conical rubber, which, in connexion with the outer case, rubbed the grain before it passed down to be acted upon by the beaters, and in the present improved form this conical rubber is covered with card teeth.

Claim.—"What I claim as new and desire to secure by letters patent is the employment of a conical rubber of card teeth, or elastic wire points, in the place of my cast iron conical rubber, as described in my original patent; and this I claim whether said card teeth, or elastic wire points, be made to act upon the grain against the rough interior of the outer cone, or shell, or against the same part lined with wire teeth, or points, as set forth."

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17. For improvements in the *Hydrostatic Press for Pressing Cotton, &c.;* John Houpt, Forkland, Green county, Alabama, Aug. 21.

The follower of this press is below the bed, hence, in the operation of pressing, it is forced upwards; and to insure its parallelism with the bed during its action, there is a connecting rod, jointed at each end of it, which rods extends upwards and are jointed to the ends of two levers, which two levers have their fulcra in the cap of the press, their inner ends being connected together by a jointed link.

The second improvement is in the employing of an air vessel with a large force pump to be used in the commencement of the operation of pressing, and before great force is required; the latter part of the pressing is to be effected with a small pump without the air vessel.

Claim.—"What I claim is, first, the manner of combining the follower of the press with its head, or cap piece, by means of two lever beams, and their connecting rods, arranged and operating in the manner, and for the purpose, set forth; and, secondly, I claim the combining with the force pump of the hydrostatic press an air chamber, the air in which shall be compressed in proportion to the force with which the press is operating, and in such manner as that it shall, by its reaction, gradually diminish the quantity of water raised from the reser-
d thus graduate the action preparatory to the operation of a
or more powerful force pump, as herein made known."

18. For an improvement in *Mill Stones;* Pendleton Cheek, Flat Rock, Henry county, Georgia, August 21.

The improved mill stones are to have furrows cut on their faces of sufficient depth to admit of a free current of air, to keep the flour or meal cool; this constitutes the whole novelty, if novelty it be.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the cutting of ventiducts, or ventilators, in mill stones, which will admit the free circulation of the air between the runner and bed stone, thereby keeping them cool and free from heating, burning, or killing the meal or flour in the act of grinding, using for that purpose any ventiducts, ventilators, or narrow deep furrows, as described."

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19. For an improvement in *Venetian Shutters or Blinds;* John Hampson, New Orleans, Louisiana, August 21.

The device which is the subject of this patent is intended to regulate the turning of the slats of the blind; to retain them in any position, and to prevent them from rattling when used in carriages, railroad cars, &c.

In the grooved cheeks which receive the ends of the slats, there is arranged a set of springs which press a narrow strip against the ends of the slats and thus keep them in place.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described of preventing the slats from rattling, and retaining them in any position in which they are placed by means of the movable strip pressed up by springs, or other other elastic substance, as described."

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20. For an improvement on the *Steelyard;* Eli Willemin, Leesburg, Carroll county, Ohio, August 21.

The fulcrum pins, or knife edges, that receive the loops of the hooks, in the improved instrument, are attached to rings that turn on the steelyard, or lever, instead of being attached to the steelyard itself. These rings are retained in their places lengthwise by means of flanches, or other known means. Instead of being made flat and having only one or two edges notched and graduated to receive weights, as in the common steelyard, this instrument is to be made square, and is graduated and notched on three sides to receive the weights, by which the capacity of the apparatus is increased; either of the notched angles may be turned uppermost.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of revolving fulcrums to steelyards and balances, by means of which the same steelyard, or balance, may be made to weigh any quantity small or great."

21. For an improvement in the machine for *Raising and Moving Buildings;* Lewis Pullman, Portland, Chatauque county, New York, August 21.

The trucks which are to be employed for removing houses are to consist of an axle having a bolster provided with a pivot, on which the body to be moved rests, the trucks are to be furnished with holes, or mortises, in their peripheries to receive hand spikes by which they are to be turned. The apparatus for raising a building, &c., consists of a frame in which there is a screw that works a sliding nut, and from this nut are suspended hooks to catch on to the lower part of the house.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the pivot and bolster referred to, with the truck employed, for removing buildings and other weights, consisting of an axle and wheels having mortises on their peripheries to which levers are adapted for moving them. Also in combination with said truck, the screw having a movable nut, with hooks attached to it, for raising buildings, as described."

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22. For an improvement in the *Moulds for pressing Glass;* Hiram Dillaway, Boston, Massachusetts, August 21.

This improvement in the mode of pressing glass consists in making that part of the mould, or moulds, which forms the inside of the mould, to communicate with a reservoir containing a large body of the melted glass, so that the pressure shall be applied to the said large mass.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the formation of the mould for pressing glass in such a manner that the hollow form, or forms, into which the articles to be manufactured or pressed shall communicate with a larger fountain filled with melted glass, so that the forms may be filled by pressure applied to the mass of melted glass in the fountain."

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23. For improvements in the *Cut-off Valves of Steam Engines;* Horatio Allen, New York city, August 21.

The patent here named was granted for improvements on the cut-off valves patented by Isaac Adams, on the 17th of May, 1838, and noticed in this journal, vol. xxiii, second series, page 237, to which the reader is referred for a description of the original; which will enable him fully to understand the following claims, viz.

"What I claim in a patent for an adjustable cut-off is as follows: 1st. I claim the combination of two independent cut-off slides, adjustable on the same rod, to be used instead of the single cut-off slide as employed in the combination patented by Isaac Adams, May, 1838, the two acting on top of the slide valve with apertures, as described in said patent, but I do not claim the slide valve with apertures; and consequently this part of my adjustable cut-off, is for an improvement on Adams' cut-off, whereby his cut-off is made an *adjustable cut-off.*

"2nd. I claim the arrangement herein denominated cut-off, with fixed

seats and adjustable slides wherein two independent cut-off slides are combined with two fixed seats, one for each end of the cylinder, and each containing an opening for the passage of steam to its respective end; said slides being adjustable on the rod carrying them, and driven by an eccentric, or cam, on the engine shaft, or by the reciprocating motion of the cross head suitably reduced, all as described.

"3rd. I claim the manner in which the two cut-off slides are made simultaneously adjustable by means of right and left hand screws on the rod carrying them, as described.

"4th. I claim the arrangement and combination for turning the rod carrying the slides, by means of a nut, or cog wheel, through the axle of which the rod passes, and is free to have a reciprocating motion lengthwise, but with which the rod must turn when the nut, or wheel, is turned, as described.

"5th. I claim the arrangement herein denominated "cut-off with adjustable seats," wherein a cut-off slide, or two cut-off slides, on the same rod are combined with two adjustable seats, one for each end of the cylinder, and each containing an opening for the passage of steam to its respective end. The cut-off slide, or slides, being permanently attached to the rod carrying them, and driven by a cam, or eccentric, on the engine shaft, or by the reciprocating motion of the cross head of the piston, suitably reduced for the required movement of the slides, and the seats being simultaneously adjusted by levers from a common shaft, or by a pinion acting on a rack from each seat or by the action of right and left handed screws or a rod passing through and carrying both seats, as described."

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24. For a method of *Preventing the Wheels of Locomotives from Sliding* on Railroads; Jordan L. Mott, New York city, August 28. (See specification, vol. ii, 3rd series, p. 348.)

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25. For an improvement in the *Spring Seats of Riding Saddles;* Thomas Mardock, Liberty, Union county, Indiana, August 28.

The claim in this patent is confined to the peculiar mode of affixing and forming the spiral spring, called by the patentee the "jews-harp spiral spring," and which is made out of a single piece of wire; but the formation of it could not well be understood without drawings, and these we deem it unnecessary to give. In this as in other spring saddles, one end of the spring is attached to the pummel, and the other to the web which is secured to the cantle of the saddle tree. The spring is easily constructed, at little cost, and will, no doubt, operate well.

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26. For a machine for *Folding and Measuring Cloth;* Joel Spalding, Morristown, La Moille county, Vermont, August 28.

The cloth to be folded by the above named machine, is first wound on to a roller which is placed in bearings in the upper part of the frame, from thence it is brought down to a table, or bed piece, provided with

two hinged retaining bars, one at each end, under which the cloth, as it is folded, is caught and held, alternately at opposite ends. There are two folding boards, one at each end, and which are hinged to pendulous levers. The end of the cloth being secured under one of the retaining bars, the edge of the folding board, on that side, is pressed against it, and pushes it across the table to the other retaining bar, which is lifted up to receive, catch, and retain the cloth, whilst the folding board on the other side performs the same operation. The pendulous levers, to which the folding boards are attached, are so connected together as that whilst one board is folding the cloth the other is being prepared for the returning operation.

Claim.—"I shall claim spreading and folding the cloth upon the surface of the table, or bed piece, in regular layers of equal lengths, as described, by means of the above described arrangement of folding boards, having a reciprocating motion, in combination with the retaining bars, operated by said folding boards, through the intervention of the lifters and levers, the whole being constructed as described."

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27. For an improvement in the *Mortise* Latch for Doors, Carriages, &c. &c.; Leonard Foster, Boston, Massachusetts, August 26.

The bolt of this latch has a long slot towards its inner end, which fits into the square spindle of the knobs, so that it can slide on it, and its outer end be lifted up by turning the knobs. There is a thumb knob attached to this bolt on its inner side, the shank of which plays loosely in a mortise in that part of the door through which it passes, the lower edge of the said mortise being provided with two or three notches into which the shank of this knob fits. By this arrangement it will be perceived that by lifting the shank of this thumb knob out of one of these notches and pushing it, (together with the bolt,) to the second or third notch, the outer end of the bolt is pushed into the hasp on the jamb of the door, and thus locked. And there being no corresponding knob on the outside it cannot be unlocked, or lifted out of the notch, except by a key, which acts upon it in the usual way; the shank of the small knob and the notches in the mortise answering the purpose of the common tumbler.

Claim.—"What I claim as new in my improved trinity mortise lock, is the manner in which I have arranged and combined the respective parts thereof so as to cause it to answer the triple purpose of a latch, a bolt, and a lock; that is to say, I claim the forming of the latch bolt with a slot, or mortise, through it to admit of its sliding back and forth upon the square shank of the knobs, or handles, whilst it is capable of being raised as a latch by said handles, and this I claim in combination with the arrangement by which the thumb knob is connected with the latch bolt, on the inner side of the door, the shank of which knob is made to operate in an opening substantially like that described; and is so constructed, also, as to be operated on by a key on the outer side of the door, in the manner described; the catch, mortises, and other parts, being likewise arranged and operating substantially in the manner described. I claim, also, the mode of applying the said

latch bolt to sliding doors by modifying the same to adapt it to this purpose."

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28. For an improvement in the *Caboose, or cooking Stove;* Michael Rocher, city of Nantes, in the kingdom of France, August 28.

The object of this improvement is to adapt the caboose used on board of ships, or other vessels, to the purpose of distilling salt water. The caboose is divided, by a diaphragm, into two compartments, an upper and a lower; the lower one contains the fire chamber and oven, which are surrounded by the salt water chamber, extending all around and over them, and the upper compartment forms a steam chamber, into which the kettles, &c., for cooking extend. A tube rises from the middle of the diaphragm to a considerable height in the steam chamber to convey the steam from the salt water compartment to the steam chamber, from which it is conducted by a pipe to the refrigerator, in which there is nothing peculiar.

Claim.—"What I claim as constituting my invention, and which I desire to secure by letters patent, is the dividing of the caboose, or cooking apparatus, into two compartments, the uppermost of which is to constitute a steam chamber, which is separated from the lower compartment, or boiler, by the diaphragm, or bottom, the two parts being combined with each other and with the condenser, substantially in the manner and for the purpose set forth."

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29. For a *Self-acting Feeder, for Supplying Steam Boilers;* Ethan Campbell, city of New York, August 28.

In this feeder the supply of water to the boiler is regulated by two floats, one in the boiler and the other in a feeding cylinder, or reservoir. The upper part of the boiler communicates with the upper part of the feeding cylinder by a pipe governed by a valve, connected with the rod of the float in the feeding cylinder, for the purpose of admitting the steam to press on the top of the water therein. The stem of this float is also in connexion with another valve which regulates the admission of water to the feeding cylinder, which is connected with the boiler below the water line, by means of a pipe provided with two lifting, conical valves, one of which is operated by a lever that is attached to the stem of the float in the boiler. When the reservoir has a sufficient supply of water, the float is borne up in it, which keeps the valve in the supply pipe closed, and that in the steam pipe open, thus admitting and equalizing the pressure of the steam on the water in the two vessels. In this condition the apparatus is in readiness to supply water to the boiler when it becomes necessary. When the water in the boiler sinks too low, the float following it, the valve in connexion with this float is opened, and as the other valve in the same pipe opens upwards, the head of water in the reservoir being higher than in the boiler, and the steam pressing equally on both, this valve is opened and the water flows into the boiler until it reaches the level of the water in the reservoir which closes the valves and stops the supply; and the discharge of the water from the reser-

voir causes the float therein to sink, and to close the valve in the steam pipe and open the one in the supplying pipe.

The claim is to the mode of combining the operation of the float in the reservoir, and the valves in the steam and supplying pipes, with the float in the boiler, and the valves in the pipe which conducts the water to the boiler.

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30. For an apparatus for *Rectifying Spirits;* Augustus V. H. Webb, city of New York, August 28.

Claim.—"I do not claim, as my invention, rectifying spirits, or whiskey, by means of carbonate of potash, chloride of calcium, or any other chemical agent having a strong affinity for water, the same having been already employed for this purpose. But what I claim as my invention, and desire to secure by letters patent, is the manner in which I employ the substances referred to for this purpose, in connexion with the cylinders and reservoirs attached to them; that is to say, I claim rectifying ardent spirits by means of one or more vertical cylinders filled with a substance having a strong affinity for water, through which the liquor is allowed to filter, combined with the reservoirs on which said cylinders rest, provided with separate faucets for letting off the water and alcohol, as described."

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31. For an improvement in the manner of combining *Elevated Ovens* with Cooking and other Stoves; Samuel B. Spaulding, Brandon, Rutland county, Vermont, August 28.

The patentee says—"In my improved mode of attaching elevated ovens to stoves, the ovens themselves are of the same kind with those in ordinary use, and which are constructed either in an oval, or cylindrical, form. In adapting the elevated ovens to stoves not originally intended to have them appended thereto, I construct what I denominate a connecting pipe, which is of a peculiar form; the lower end of it has an opening of such size as to fit on the collar, or rim, of the stove, to which the stove pipe is ordinarily fitted. The upper end of this connecting pipe, which is to be attached to the lower side of the oven, is widened out so as to embrace two openings which lead from it into the flue that surrounds the elevated oven; through these openings the heated air from the stove passes into said flue at a suitable distance from the centre and ends of the oven to insure the regular diffusion of heat. When the elevated oven is not to be used, and it is desired to carry the heated air directly to the exit pipe, it is made to pass along a flat flue which encircles one half of the oven, the course of the draught being governed by means of suitable dampers. By means of this flat flue the apparatus is rendered peculiarly compact."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner herein described of combining the elevated oven with the stove by means of a connecting pipe, constructed and arranged in the manner set forth; that is to say, having an open-

ing at its lower end adapted to the neck, or collar, of the stove, and widening out at its upper end so as to embrace the two openings leading into the oven flue. I also claim, in combination with the foregoing, the flat flue leading from the connecting pipe to the exit pipe, and embracing the outer case of the oven in its passage, said flue being furnished with a valve, or damper, which, in combination with the other valves, or dampers, will govern the passage of the heated air from the stove, or through the flue, at pleasure. The whole apparatus being constructed, combined, and arranged substantially in the manner made known."

Practical & Theoretical Mechanics & Chemistry.

MR. MALLET'S *Processes for the Protection of Iron from Oxidation and Corrosion, and for the Prevention of the Fouling of Ships.*

[CONTINUED FROM PAGE 211.]

2. *The Palladiumizing Process.*

The articles to be protected are to be first cleansed in the same way as in the case of zincing, namely, by means of the double salts of zinc and ammonia, or of manganese and ammonia; and then to be thinly coated over with palladium, applied in the state of an amalgam with mercury.

[The directions given as to this process are meagre, in comparison with those supplied for the other processes; but we are informed that the protection afforded by the palladium is as absolute as that by the zincing, and by no means so costly as to exclude it from economical use.]

3. *The Zoofagous Paint.*

After the iron vessel has been zinced and varnished, in the manner before described, it is done all over (above the varnish, of course,) with a strong bodied thick paint. This is composed of drying linseed-oil, red lead, and sulphate of barytes, (or white lead may be used, but not so advantageously,) and a little turpentine. To every 100 lbs. of these ingredients, when mixed, is to be added 20 lbs., or thereabouts, of oxychloride of copper, and three pounds of a mixture composed of hard yellow soap melted with an equal weight of common rosin, and a little water. The colour originally sold in commerce under the name of "Brunswick green," was an oxychloride of copper; but the present Brunswick green of commerce is a different thing, and will not answer. The oxychloride of copper may be obtained at a cheap rate, by various known methods, which it is unnecessary to detail. When the whole of the hull of the vessel has been done over with the paint, it must be permitted to dry and harden for three or four days, before the ship is floated out of dock. The entire series of operations are now completed; and the hull of an iron ship so treated will, Mr. Mallet assures us, "resist all corrosion from the action of air and fresh or sea water, and not be liable to 'fouling,' by the adhesion of marine animals and plants."

Mr. Mallet adds, that the power of the zoofagous paint to prevent 'fouling' arises from the fact, that the insoluble, or difficultly soluble salts of copper, and of certain other metals, are so noxious to the life of marine, or aquatic, animals and plants, which generally attach themselves to ships' bottoms, that they will not adhere or grow upon a surface so treated. The paint, therefore, is only a vehicle for poisonous matter, for which purpose it is requisite that it should have sufficient adhesion to resist the ship's motion, but still should have a slight degree of solubility in water, so that the poisonous matter may be taken up by the absorbent or capillary vessels of any adhering animal or plant. This latter property is given it by the addition of the resinous soap, the proportion of which should be varied to suit the climate to which the ship is going, more being used in frigid, and less in tropical climates. Mr. Mallet prefers using the oxychloride of copper, and has found it by much the most efficacious; but any insoluble, or difficultly soluble, salt of copper, mercury, arsenic, or antimony, or any combination of these, whether soluble or insoluble, may be substituted for it.

General Observations.

Although Mr. Mallet deems it *advisable* that where new ships are intended to be protected by zincing, the iron should go through the whole of the processes before directed, namely, the cleansing, the coating with the triple alloy, the varnishing, and the final coating with the zoofagous paint, he remarks that they are not all equally essential, and points out how the same effects may be produced, though attended with less favourable circumstances, by the adoption of a part only of these processes:

"For, supposing the plates and ribs of iron were merely coated with the triple alloy of zinc, mercury, and potassium, or sodium, without the addition of the protective varnish and zoofagous paint, it is certain that, on the exposure of this alloy to the action of air and water, the positive metal at the surface would be first acted on, and the surface become shortly covered with a very thin coat of amalgamated zinc, which is known not to be acted upon by fluid menstrua, (except under peculiar conditions which do not exist in the case here supposed,) and does not, as I have found by experiment, gather to itself, when exposed to sea or fresh water, any of that calcareous coating which is productive of the fouling of vessels. The advantage gained by varnishing over this triple alloy coating is of a twofold nature. In the first place, it serves as a mechanical protection to the coating, and thereby to increase its durability; and, secondly, it shields the alloy from contact with the zoofagous paint, some of the ingredients of which would exert an injurious chemical action on the alloy. The office, therefore, of the triple alloy is simply to prevent corrosion and oxidation, (including, where used by itself, that of preventing the formation of calcareous adhesions;) that of the varnish, to protect the triple alloy; and that of the zoofagous paint, to prevent fouling, by the destruction of any marine animals or aquatic plants which may seek [to a]ttach themselves to the protected surfaces."

When the addition of the zoofagous paint is not required to prevent fouling, as in the case of articles exposed to the action of the atmosphere only, Mr. Mallet states that any desirable colour may be given to the protecting varnish, by a mixture of colouring materials, but that care must be taken that these colouring materials consist of peroxides not liable to be acted on by air or moisture. The best method to adopt, however, with such articles, is said to be, to pay the varnish all over with a coat of oil paint.

Finally, although the triple alloy is directed in the first instance, to be employed at the fusing temperature, Mr. Mallet states that, by the addition of a larger portion of mercury, articles of cast or of wrought iron or steel may be coated with that alloy at a lower temperature, and even in a cold state, by means of simple contact and friction.

Mech. Mag., Jan. 1842.

On the Existence of Sulphur in Plants.

M. Vogel, Sen., remarks, that it has been proved by the late M. Planche and other chemists, that many plants contain sulphur. Water cresses, *Lepidium sativum*, L., are among those which especially contain much sulphur.

As soils distant from volcanoes do not contain perceptible traces of sulphur, it appears to M. Vogel not impossible that plants, which are much disposed to assimilate sulphur, may have the property of deriving it from the decomposition of the sulphuric acid of sulphates. M. Vogel, however, found that seeds placed in a soil perfectly free from sulphur and sulphates, yielded plants which contained a notable quantity of sulphur.

The soil employed for this experiment consisted of coarsely powdered white glass; it was first strongly heated, but not fused, in a crucible, and being afterwards washed with boiling water, not the slightest trace of any sulphate could be detected.

Seeds of water cresses kept in a moist state were placed in this, and when the plants were several inches in height, they were removed with their roots; after having washed the plants, the white fibrous roots were cut off, and these as well as the plants were dried, and on heating them in a retort, it was found that both of them yielded considerably more sulphur than the seeds contained; the expressed juice of the young plants cultivated in the powdered glass also contained soluble sulphates. The seeds of water cresses, sown in coarsely powdered quartz, flint glass, and very fine silica, obtained from silicated hydrofluoric acid, yielded similar results with respect to sulphur and sulphates, though the plants did not flourish so well in the last as in the two former substances.

To obtain approximative results as to the quantity of sulphur in the water cress seeds and the plants which they yielded, the following experiments were made:—The seed [100 grains?] was heated to redness in a retort, and the gases disengaged were received into a solution of potash; acetate of lead was added to the alkaline liquor as long as precipitation occurred. The precipitate was of a brownish colour,

and consisted of hydrate, carbonate, and sulphuret of lead; the two former were dissolved by dilute nitric acid, and the sulphuret of lead remained, which, after washing and drying, weighed 0.95 gr., which indicated 0.129 gr. of sulphur. According to this experiment, 100 grs. of the seed contained 0.129 gr. of sulphur.

The young plants obtained from the growth of 100 grains of the seed were similarly treated; their weight was 2040 grs.; they yielded by the above described processes 15.1 grs. of sulphuret of lead, equivalent to 2.03 grs. of sulphur: consequently the dried plants contained nearly fifteen times as much sulphur as the 100 grs. of seed which produced them.

Another experiment was made by projecting into a red-hot platina crucible small successive portions of a mixture of powdered cress leaves with nitrate and carbonate of potash. The residue, heated in the crucible and treated with nitric acid, gave a considerable precipitate with chloride of barium, but, on account of the sulphate of potash which the plant contains, the quantity of sulphur cannot be accurately determined by this process, although in general it is preferable to that above described; 100 grs. of the leaves yielded in this way 4.6 grs. of sulphate of barytes, equivalent to 0.624 gr. of sulphur; but the quantity of sulphate of potash is to be deducted from this.

As the growth of the young plants of water cresses took place in a soil devoid of sulphur and sulphates, and in a room which contained no sulphurous vapours, the origin of the sulphur, M. Vogel remarks, is to him a perfect enigma, and at present he confesses that he is unable to give a satisfactory explanation of it.—*Jour. de Pharm. et de Chim.*, Mai 1842.

Lond. & Ed. Philos. Mag., July, 1842.

Velocity of Water through Pipes.—Mr. Rofe's Experiments at the Birmingham Water Works.

The calculations are for the head of water necessary to keep up a given velocity for every 100 feet run of pipe. The tables were two: in the first V represents the table of velocities in feet per minute, and T the constant numbers for those velocities:

V	T
60	8.62
70	11.40
80	14.58
90	17.95
100	21.56
110	25.35
120	29.70
130	34.
140	38.90
150	44.
160	49.50
170	55.66
180	62.13

In the latter, D represents the diameter of the pipes in inches, and t the constant numbers for those diameters:—

D	t
3	
4	.028
5	.053
6	.078
7	.104
8	.134

As an application of these tables, the following problem was proposed; it having been premised that the formula for their use was—

$$\frac{T}{D+t} = H$$

where H represents the height, or head of water. It is required, then, to determine what head of water will be necessary to send water by an engine through 1,500 feet of six inch pipes to an elevation of 80 feet, at a velocity of 180 feet per minute. Now, by the table, we see that the constant number for 180 feet velocity is 62.13, and the constant number to be added to six inches is .078,

$$\text{and } \frac{62.13}{6.078} = 10.22 \text{ inches,}$$

which is the head of water required to keep up the velocity of 180 feet per minute for every 100 feet run; which, being multiplied by 15, (the number of hundred feet through which it has to pass,) gives 153 inches, or 12 feet 9 inches. This, added to 80 feet, will give 92 feet 9 inches as the column of water which the pump must lift.

Lond. Mech. Mag., May, 1842.

Description of the Tanks for Kyanizing the Timber for the permanent Way of the Hull and Selby Railway.

The apparatus consists of two tanks, a reservoir, two force pumps, and a double air pump. The tanks are cylindrical, with flat ends, and are made of wrought iron plates, nearly half an inch in thickness. They are 70 feet in length, and six feet in diameter. At each extremity is a cast iron door, flat on the outside, and concave on the inner side, provided with balance weights for raising and lowering it. Each end is strengthened by five parallel cast iron girders, whose extremities are held by wrought iron straps, riveted on to the circumference of the tanks. Notwithstanding the great strength of these girders, several were broken by the pressure applied during the process. The vessels are lined with felt, upon which is laid a covering of close jointed fir battens, fastened with copper rivets. This precaution is necessary to prevent the mutual deterioration which would arise from the contact of the iron and corrosive sublimate. There was originally only one brass force pump, two inches diameter, and six inches stroke. This being found insufficient, another was added of four inches diameter,

and henceforward a pressure of 100 lbs. per square inch was easily obtained. The air pump is ten inches diameter, and fifteen inches stroke. Its construction is of the ordinary kind. The author gives, in an appendix to the paper, a minute description of the various parts of the apparatus, with the details of their dimensions and weight. The process is simple and rapid; the corrosive sublimate is first mixed with warm water in a trough, in the proportion of one pound of the former to two gallons of the latter; the clear solution is then poured off into the reservoir, where water is added till it is diluted to the proper point, which may be ascertained by a hydrometer. A more perfect test is the action of the solution upon silver, which it turns brown at the requisite degree of saturation. The operations of exhaustion and pressure employ eight men for five hours, the whole process occupying about seven hours, during which time from 17 to 20 loads are kyanized in each tank. It is desirable that the timber should remain stacked for two or three weeks after kyanizing, before it is used. It was found that about three-quarters of a pound of corrosive sublimate sufficed to prepare one load (50 cubic feet) of timber. About 337,000 cubic feet of timber were kyanized, the average expense of which, including part of the first cost of the tanks, was about *5d.* per cubic foot. The timber was tested after the process, and it was found that the solution had penetrated to the heart of the logs.

Ibid.

Action of Salts on Living Plants.

From the various experiment which M. Vogel, Sen., has made on the action of salts on living plants, he has arrived at the following conclusions:—

1st. That plants with their roots when immersed in a solution of sulphate of copper, totally absorb the salt, convert it into proto-sulphate, and die quickly.

2nd. That acetate of copper produces the same effects; the salt absorbed becoming proto-acetate of copper.

3rd. That plants absorb sulphate of magnesia, nitrate of potash, and iodide of potassium, and die more or less quickly.

4th. That the sulphates of zinc and manganese are absorbed by plants without suffering decomposition, and the plants die.

5th. That plants absorb nitrate of cobalt and nickel, without being able to absorb the whole of them from solution; but they die, and the same effect is produced by emetic tartar.

6th. That the oxalate and tartrate of oxide of chromium and potash are slowly absorbed by plants, and the bichromate of potash much more quickly. The *Datura Stramonium* and *Galega officinalis* absorb the salt of chromium with the greatest rapidity; they become of a yellow colour and die.

7th. That plants absorb nitrate of silver; but they decompose it, and the oxide of silver is reduced to the metallic state.

8th. That plants absorb also, and totally, the protonitrate of mercury from solution, but the salt is decomposed.

9th. That corrosive sublimate is absorbed by plants; some of them decompose it into calomel, and others absorb it without decomposition.

10th. That plants slowly absorb acetate of lead; and it is decomposed by some plants and not by others.

11th. That plants which contain much carbonate of lime, such as the *Chara vulgaris* and the *Stratiotes aloïdes*, do not absorb a salt of copper from solution: the same also occurs with the *Cereus variabilis.—Jour. de Pharm. et de Chem.*, Mai 1842.

Lond. & Ed. Philos. Mag., July, 1842.

Method of Distinguishing between weak Solutions of Nitrates and Chlorates. By M. Vogel, Jr.

When a few drops of tincture of litmus are added to a solution of nitrate of potash so as to render it blue, and afterwards concentrated sulphuric acid, the tincture is merely reddened by the sulphuric acid, and by the nitric acid set free, but it is not at all decolorated. A solution of chlorate of potash, on the contrary, which has been rendered blue by tincture of litmus, is entirely decolorated by the addition of concentrated sulphuric acid, a result by which the chlorate is effectually distinguished from the nitrate.

This effect is produced with the chlorate when one part is dissolved in sixty-four parts of water, but it ceases with eighty parts of water; but a solution of indigo is decolorated when water contains only $\frac{1}{500}$th of its weight of chlorate of potash.

This method of distinguishing the chlorates from the nitrates, both in very dilute solutions, has besides the advantage of giving certain results, in decolorating the tincture of litmus, even when the chlorates are accompanied with chlorides and other salts.

Tincture of litmus is not decolorated by a very weak solution of nitrate of potash on the addition of sulphuric acid, even when some hundredths of common salt or of other chlorides are present: it is decolorated only when the nitrate of potash is dissolved in a concentrated solution of common salt.—*Ibid.*

Ibid.

Method of Lowering the "Lights" in some particular Engravings executed in the Wood-cut manner.

Sir.—I here submit a new method of lowering the "lights" on the surface of some particular engravings executed in the wood-cut manner, as, for instance, the copper blocks produced by electrography, and those formed by Mr. Woone's stereotype process: the lines of the pictures in both styles being all one height, on account of the design being engraved on a flat, even surface. The metal casts or blocks are first "stopped" out in the darkest tint by the application of a hair pencil dipped in some strong varnish, as that of copal, asphaltum, or seed-lac, the first mentioned being the most preferable; and then attached to and immersed as positive plate in the single-cell voltaic ap-

paratus used in electro-metallurgic experiments, letting it remain until the parts untouched with varnish have been corroded to the requisite depth. It should then be taken out, dried, and the varnish brush applied to those portions which may be considered deep enough, repeating alternately the varnishing and corrosion, until the cut is graduated to your desire. The character of the engraved lines will not be much injured by the electro-etching process, as the corrosion proceeds with evenness and regularity. The more simple application of nitric or other suitable acid, might probably be found efficacous when the design is of a bold or rude character, and strongly lined.

As a mode of lowering blocks of the above description for typographic printing has long been sought for, the insertion of this little hint may be of service to some of the readers of the Mechanics' Magazine. I have the honour to be, your obedient servant,

M. T. Brazendale.

Lond. Mech. Mag., May, 1842.

Number of Furnaces in Great Britain.

We are enabled this week to furnish a tabular statement, showing the number of furnaces in and out of blast in the United Kingdom, with the weekly "make," in most instances taken from data on which no question can arise as to the accuracy of the returns, while in other cases, we have adopted such estimates as appeared to us, from the information derived, to be sufficiently near for the attainment of the object in view—that of presenting to our readers a complete table, wherein the several iron works of the United Kingdom are classified, with the names of the proprietors, and the weekly product, as also the aggregate returns.

The following summary will at once exhibit the present position of the iron trade:—

	No. of furnaces.	In blast.	Av. weekly make.
South Staffordshire, 1st div.	87	54	4200
" 2d div.	48	32	2475
North Staffordshire	18	12	620
Shropshire	36	24	1355
Derbyshire	15	14	577
Yorkshire	30	24	1059
Scotland	91	65	5525
Northumberland	7	2	120
Durham	2	2	120
Forest of Dean	8	3	120
South Wales	162	112	9000
North Wales	21	6	360
Ireland	2	—	—
Total	527	350	25,531

It will be thus seen, that the number of furnaces in the United Kingdom is 527, of which 350 are in blast, and 177 out of blast, the

quantity of pig iron made, or capable of being made, at the present time (by the furnaces in blast,) being 1,327,612 tons per annum, from which, however, we may deduct 20 per cent.—leaving 1,062,090 tons as the actual make. On comparing this statement with an abstract of the quantity of pig iron estimated to have been manufactured in the year 1839, and which is embodied in Mr. David Mushet's work, entitled *Papers on Iron and Steel,* we find the average weekly make at that period to have been as follows:

	Furnaces.	In blast.	Av. weekly make.
South Staffordshire	126	106	6660
North Staffordshire	10	7	350
Shropshire	34	29	1555
Derbyshire	16	14	660
Yorkshire	29	24	1010
Newcastle-on-Tyne	5	5	250
Scotland	54	54	3790
Forest of Dean	8	5	350
South Wales	127	122	8730
North Wales	20	13	650
Total	429	379	24,005

or an annual make of 1,248,260, which is called in Mr. Mushet's work 1,248,781 tons. It will be thus seen, that, comparing the present make with that of the average of 1839, the number of furnaces in that year was 429, of which 379 were in blast; whereas, in February, 1842, the number had increased to 527, of which only 350 were in work, the majority being at a reduced make of 25 per cent.—the aggregate quantity made weekly being, in 1839, 24,005 tons, and in February, 1842, 25,531 tons—there being an increase, in the past two years, of 98 furnaces, equal to an additional make of 407,680 tons per annum (about one-third the average make,) while the number of furnaces in blast in 1839 was greater than those enumerated as being in operation at the present time.

We do not propose entering further into the subject, but having collected that information, which is not only interesting, but valuable, as statistical detail, we leave to our correspondents to furnish such additional particulars as they may possess, having, so far as lies in our power, devoted our attention to the subject.

Mining Jour., March, 1842.

METEOROLOGICAL OBSERVATIONS FOR JULY, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	70°	87°	29.90	29.90	SW.	Moderate	.70	Par. cloudy.	Par. cloudy; shower
	2	72	82	29.96	29.96	W.	do	.26	Par. cloudy.	Par. cloudy; shower.
	3	72	80	30.00	30.00	SW.	Brisk	.15	Cloudy.	Cloudy; shower.
	4	71	82	30.00	29.96	S. SW.	Moderate		Cloudy.	Cloudy.
	5	71	80	29.96	29.96	SW.	do		Cloudy.	Cloudy.
	6	72	71	29.80	29.83	SW.	do	1.92	Cloudy.	Showers.
	7	61	73	30.00	30.05	SE.	do		Cloudy.	Clear.
⊗	8	66	75	30.00	29.95	SE.	do		Cloudy.	Cloudy.
	9	72	76	29.85	29.85	W.	Brisk	1.85	Cloudy.	Shower.
	10	65	72	29.95	30.00	NW.	Moderate		Cloudy.	Cloudy.
	11	63	77	30.00	30.05	E.	do		Clear.	Clear.
	12	62	80	30 05	30.00	E. SE.	do		Cloudy.	Clear.
	13	64	83	29.90	29.90	SE.	do		Fog.	Clear.
☾	14	72	83	29.80	29.80	S.	do		Cloudy.	Partially cloudy.
	15	65	64	29.80	29.80	NE.	do		Cloudy.	Cloudy.
	16	62	66	29.80	29.80	NE.	do	1.90	Rain.	Rain.
	17	63	80	29.77	29.80	N.	do		Clear.	Clear.
	18	68	82	29.78	29.78	E.	do		Lightly cl'dy	Lightly cloudy.
	19	70	86	29.78	29.78	SW.	do		Lightly cl'dy	Clear.
	20	69	82	29.78	29.85	W.	do	.15	Shower.	Partially cloudy.
	21	60	78	30.10	30.10	E.	do		Clear.	Clear.
☺	22	62	78	30.15	30.15	S. SW	do		Clear.	Clear.
	23	70	83	30.15	30.15	SW.	do		Cloudy.	Clear.
	24	72	83	29.93	29.93	SW.	do	.59	Cloudy.	Shower.
	25	66	74	30.05	30.15	W.	do		Clear.	Clear.
	26	63	82	30.10	30.04	W.	do		Cloudy.	Clear.
	27	68	87	29.94	29.94	SW.	do		Clear.	Lightly cloudy.
	28	72	84	29.90	30.00	E.	do	.38	Par. cloudy.	Rain.
	29	72	82	30.00	30.00	SE.	do	.03	Cloudy.	Clear; rain.
☽	30	73	86	29.85	29.80	W.	do		Clear.	Clear.
	31	76	87	29.70	29.70	SW.	Brisk		Par. cloudy.	Cloudy.
		67.87	79.52	29.93	29 93			7.93		

Thermometer.		Barometer.	
Max. 87.00 on 15th, 27th & 31st. Min. 60.00 on 21st.	Mean, 73.695	Max. 30.15 on 22d, 23d & 25th. Min. 29.70 on 31st.	Mean 29.93

AUGUST, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	54°	68°	29.90	29.95	W.	Moderate		Par. cloudy.	Par. cloudy.
	2	54	72	30.06	30.10	W.	do		Clear.	Clear.
	3	59	76	30.00	30.03	E.	do		Clear.	Flying clouds.
	4	62	70	30.00	30.00	NE.	do		Cloudy.	Cloudy.
	5	68	65	29.80	29.80	NE.	Brisk	.50	Rain.	Drizzle.
⊗	6	60	72	30.00	30.15	SE.	do		Cloudy.	Lightly cloudy.
	7	66	71	30.00	29.90	NE.	do	.25	Rain.	Showery.
	8	67	76	29.90	29.85	SE. SW.	do		Cloudy.	Lightly cloudy.
	9	68	74	29.90	29.93	W.	do		Cloudy.	Cloudy.
	10	68	78	29.88	29.90	NE.	do		Fog.	Cloudy.
	11	68	76	29.90	29.90	W.	do	.23	Rain.	Lightly cloudy.
	12	68	75	29.86	29.86	SE.	do	.05	Cloudy.	Cloudy; rain.
☾	13	67	76	29.85	29.90	E.	do	.07	Par. cloudy.	Rain.
	14	65	80	30.05	30.00	W.	do	.65	Clear.	Clear; shower.
	15	65	79	29.94	29.86	W.	do		Cloudy.	Hazy.
	16	64	80	29.90	30.00	SW.	do		Cloudy.	Hazy.
	17	70	75	29.90	29.90	SE.	do	.35	Cloudy.	Showery.
	18	73	84	29.83	29.80	SW.	do		Clear.	Clear.
	19	70	82	29.80	29.90	W.	do		Clear.	Clear.
☺	20	64	80	29.90	29.95	W.	do		Lightly cl'dy.	Clear.
	21	64	78	30.00	30.05	W.	do		Clear.	Clear.
	22	64	78	30.15	30.20	NE.	do		Clear.	Clear.
	23	63	75	30.20	30.20	E.	do		Clear.	Clear.
	24	66	74	30.10	30.20	E.	do	1.20	Cloudy.	Rain.
	25	72	79	29.83	29.83	SW.	Brisk		Cloudy.	Clear.
	26	73	82	29.83	29.83	SW.	do	.35	Cloudy.	Clear; shower.
	27	74	82	29.83	29.74	SW.	Moderate		Cloudy.	Flying clouds.
☽	28	71	78	29.74	29.65	W.	do		Cloudy.	Cloudy.
	29	71	83	29.65	29.66	W.	do		Clear.	Clear.
	30	64	75	29.70	29.96	E.	do		Clear.	Clear.
	31	60	77	30.10	30.10	SW.	do		Clear.	Clear.
		65.87	76.45	29.92	29.94			3.65		

Thermometer.		Barometer.	
Maximum 84 on 18th. Minimum 54 on 1st and 2nd.	Mean 71.16	Max. 30.20 on 22d 23 & 24th. Min. 29.65 on 28th & 29th.	Mean 29.93

// JOURNAL

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NOVEMBER, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Reaction Water Wheels used in the United States; and on the Turbine of M. Fourneyron, an Hydraulic Motor, recently used with the greatest success on the continent of Europe. By ELLWOOD MORRIS, Civil Engineer.

[CONCLUDED FROM PAGE 227.]

On Turbine Water Wheels.—Having completed our remarks upon *reaction water wheels,* by endeavouring to show *that they are not superior in effect to undershot wheels,* unless when acting in backwater; we will now proceed to consider the *turbine* of M. Fourneyron, which—whether employed upon falls as low as three feet, or as high as 354 feet—whether immersed in backwater or not—realizes continually, with remarkable uniformity, a proportion of useful effect *quite as great,* in comparison with a given power expended, as can be obtained from the best overshot wheels, working under the most favorable circumstances; in other words, whilst the co-efficient of effect belonging to the turbines, continually approximates to 0.800, it remains nearly invariable, under all circumstances of fall and position; this peculiar wheel possessing the remarkable property of being equally effective and suitable, in almost every situation where water wheels can be used as motors.

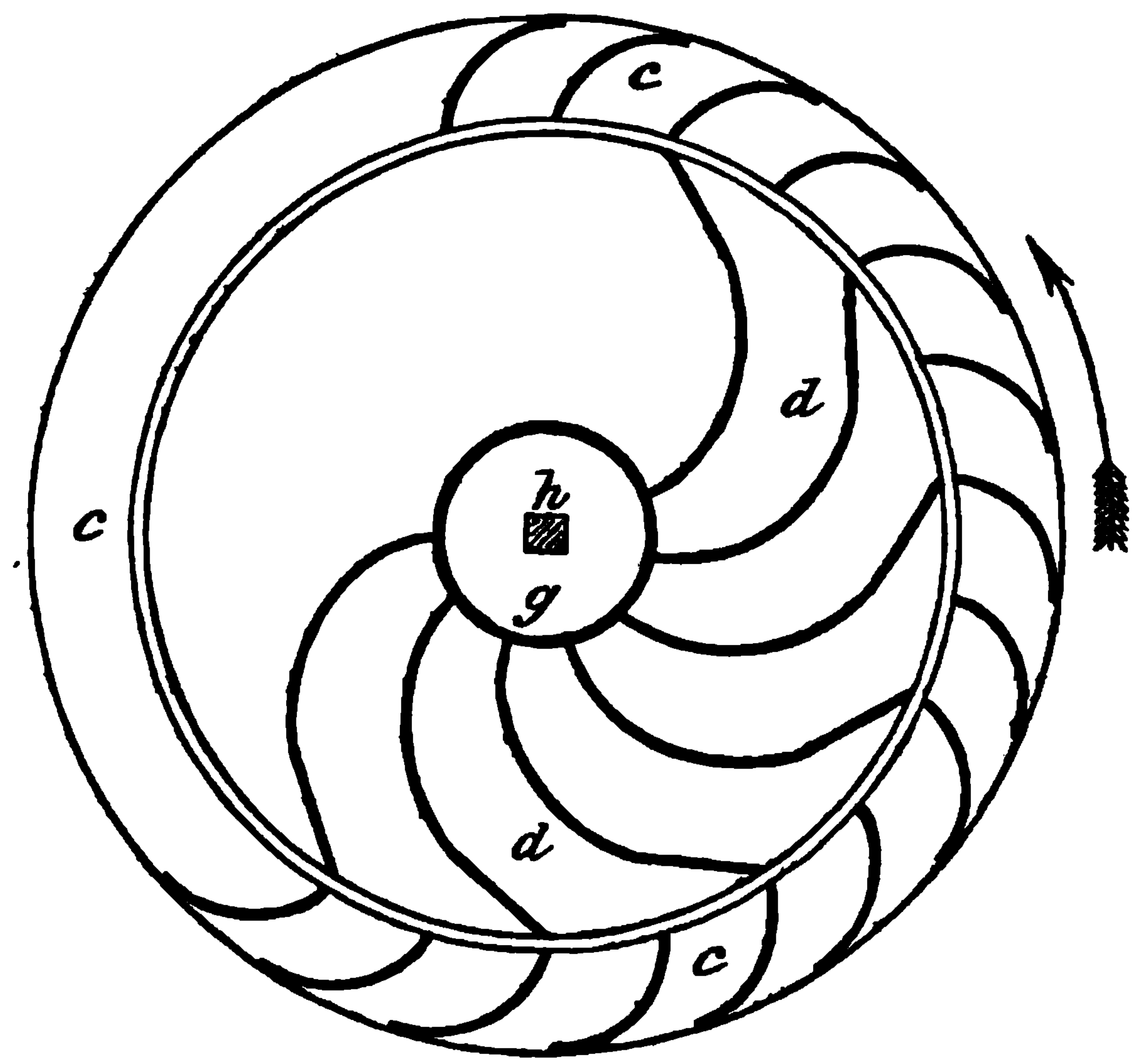
The *turbine,* or water wheel invented by M. Fourneyron, is like

the reaction wheel, formed of cast iron, (often in a single piece,) and like it, is usually made to revolve horizontally about a vertical axis.

In the following sketches, *c c* represents a horizontal section of the wheel rotating in the direction of the arrow, about a vertical axis passing through a pipe attached to the *fixed disk d d;* which disk is surmounted by a series of *guides*, curved in a particular manner, whereby the water is conducted to the wheel, made to issue tangentially, and press upon the curved buckets perpendicularly, or nearly so, thus producing a revolving motion.

The admission of water from the upper level to act upon the wheel, is regulated by an annular sluice gate, which envelopes the curved guides, and shuts down upon the fixed disk; when this sluice gate is raised, the water issues out between the curved guides and turns the wheel; when closed, a water tight joint is formed, and none can pass to the lower level; all which will be easily comprehended, from an examination of the following description and diagrams.

Fig. I.



General Description of a Turbine.

Fig. I exhibits part of a horizontal section of a *turbine;* in which *c c c* shows *the wheel* turning in the direction of the arrows; *d d, the fixed disk,* with its curved guides attached, the spaces between which are the sluices whence the water issues, and presses upon the curved buckets of the wheel; *g, the shaft pipe,* which sustains *the fixed disk* in an unchangeable position upon its lower extremity, and is itself

sustained at its upper end by the carpentry above the forebay; through this pipe *the shaft* of the wheel *h* rises to communicate motion to the works driven by *the turbine;* the open annular space between *d* and *e* represents the place of the sluice gate, which is a short portion of a thin hollow cylinder of cast iron, moving vertically, in contact with *the fixed cylinder n n,* at its upper part, and closing down water tight upon the fixed disk; wooden blocks are screwed upon the inside of the annular sluice gate, which slip between the curved guides and are rounded above and below, in order to improve the ajutage, and thus facilitate the efflux of the water, as is more clearly seen at *f* and *e*, Fig. II.

Fig. II.

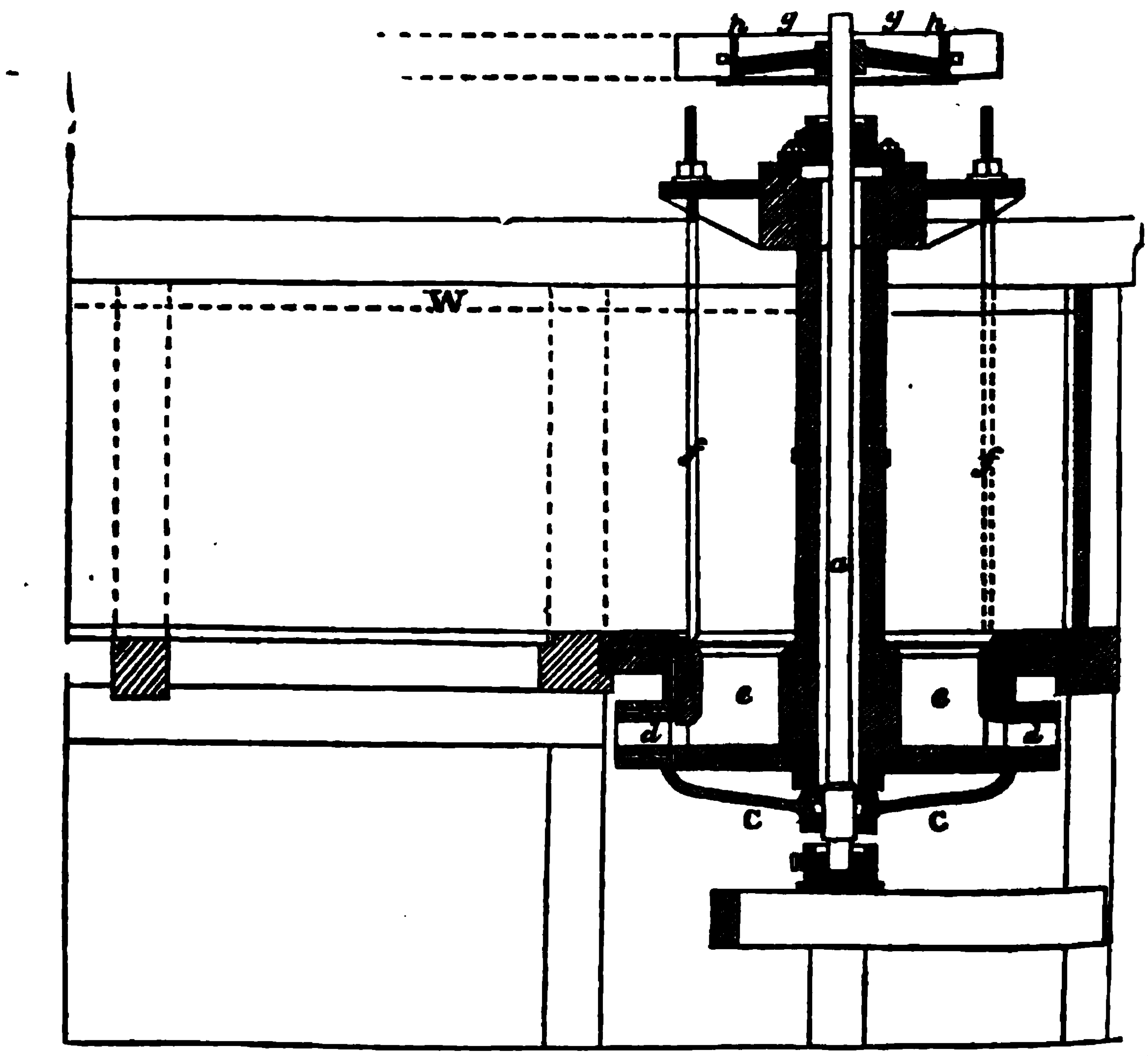
h

Fig. II exhibits a vertical section of a *turbine; a a,* the surface of water in the upper level, or forebay; *b b,* the surface of water in the lower level, or tail race; *c c, the wheel* with buckets curved in plan; *d d, the fixed disk* and *curved guides* firmly supported by *the shaft pipe g; e e, the annular sluice gate,* with its wooden internal cushions *f f,* to improve the ajutage; *g g, the shaft pipe; h, the shaft* upon which *the wheel c c* is firmly fixed at its lower part, so as to carry the shaft with it in its movement of rotation; this shaft runs upon a suita-

ble step, or pivot, at *o: i i,* two vertical rods, which, with a third not seen in the sketch, are attached to the annular sluice gate at equal distances apart, and which being all acted upon equally by an arrangement of screws and spur gear, raise or depress the annular gate with perfect regularity; *k k, a leather collar,* extending entirely around the upper circumference of the annular sluice gate, which collar being pressed outwards by the water, against the concave surface of the concentric *fixed cylinder n n,* effectually secures this joint in a manner that prevents leakage; *l l, the forebay,* the water of which has free communication with the sluices of the turbine, by the whole circular space from *k* to *k*; and finally, *m* is the *tail race* through which the water escapes, after having actuated the turbine.*

To illustrate still more clearly the construction and mode of operation of the turbines, we subjoin a brief extract from a paper on this subject, by George Rennie, Esq., F. R. S.. &c., published in this journal for 1840, and also reprint the wood cuts accompanying that paper.

Fig. III. VERTICAL SECTION.



* We will here observe that the curves of the buckets of the turbine, and of the guides upon the fixed disk, must be traced in a particular manner, which it requires some study to master; and that without a close attention to this point, these wheels *may fail* to realise a proper degree of useful effect, as was the case with several in France, which were not constructed with sufficient care.

Description of the Engravings.

L, beam with which the lever of the brake is connected by a spring balance marked D. W, water level. F, friction wheel. D, dynamometer.

a, Main axle of the turbine.

b b, Shaft pipe enclosing it

C C, The lower part, or shell, of the turbine wheel.

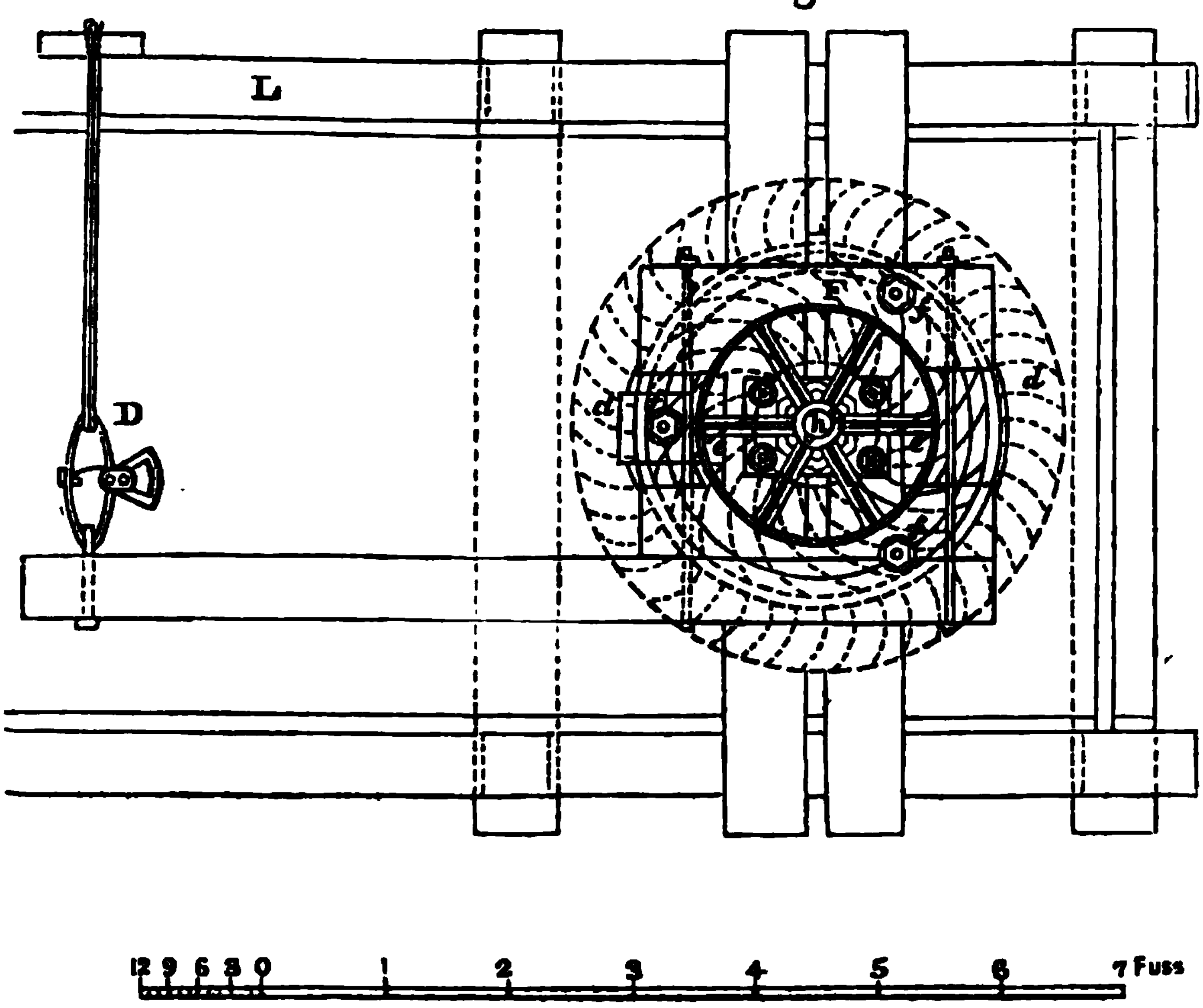
d d, The curved buckets, or vanes, against which the water presses in escaping between them from the wheel.

e e, The curved guides upon the fixed disk.

f f, Rods and screws for manœuvring the annular sluice gate.

g g, The annular sluice gate.

Top View. Fig. IV.



" *Operation.*—To set the machine in motion, the sluice *g g* is drawn up by means of the screws and bolts *f f.* Then the water which is continually resting on the fixed disk P P, with the pressure of the whole fall, immediately issues out between the curved guides, and impinging upon the curved buckets of the turbine, causes it and the main shaft, with all its machinery, to revolve rapidly."

Such is the description of Mr. Rennie, which is reprinted at the risk of repetition, with the particular purpose of drawing attention to the

Brake, or Friction Dynamometer, of M. De Prony, by means of which the useful effect of the turbine has been usually measured.

The *brake* consists simply of two stout pieces of wood, embracing a smooth wheel firmly fixed upon the shaft of the turbine, and cut out concave to fit, or nearly fit, this wheel; these collar beams are connected together, by two screws with heavy nuts and washers, by means of which they may be made to embrace the fixed wheel, with any necessary degree of force, or even to stop its motion.

To one of these beams, a long lever is attached, and connected at its outer end, either by a spring balance or a scale and weight, with some fixed point of the building.

This is the whole machine (see the sketches) which, as a dynamometer, is remarkably accurate, as well as perfectly simple; all that is necessary is, that the friction should be made regular, and the wooden collar beams prevented from burning; both these objects are effectually attained, by the simple precaution of causing a small stream of water to fall constantly upon the rubbing surfaces of contact.

Then the screws being set up with any moderate force, weights are added if a scale is used, or the spring dynamometer is made to act, so as to keep the lever fixed in a position perpendicular to the pull of the balance.

If, when the shaft is revolving with speed, the lever remains regulated by the balance weights applied, in the position above mentioned without much vibration, *the weight placed in the scale, (or indicated by the spring balance,) multiplied by the velocity the end of the lever would take if free to revolve,* will give a correct measure of the net useful effect of the machine.

It was with this simple and correct instrument, devised for such purposes by M. de Prony, that all, or nearly all, of the experiments made by M. Morin and others, upon the economical value of the turbine have been performed.

Comparison between Reaction and Turbine Wheels.

The wheel of the turbine alone, is not very dissimilar in general appearance to the reaction wheel, though totally different in its mode of action.

The difference lies in the addition of a fixed disk surmounted by curved guides, and in an entirely different curvature given to the buckets; these variations change the whole character of the machine.

The *reaction wheel* derives its motion solely from the *reaction* of the spouting water against very oblique vanes, so curved as to facilitate this spouting to the utmost extent; whilst the water is left free to take its own course, in entering the wheel.

In the *turbine,* on the contrary, the effect is to restrain, as much as possible, the spouting of the water at a high velocity, and force it to act against the vanes, or buckets, almost perpendicularly *by its pressure,* and not obliquely *by its impulse:* hence it is that the curved guides are established to conduct the effluent water, and constrain it to act tangentially against the vanes, which are curved around so much as to prevent the water from leaving them until its pressure is exhausted, or until, thrown outwards by centrifugal force, it drops from the wheel inert and almost destitute of motion.

In the *reaction wheel,* the greater the velocity of the spouting water the greater is the impulsive reaction, and consequently the greater is the effect produced—but in the *turbine,* the less the velocity of the effluent water, and the less its impulse, the greater is the effect, because its full pressure is then made to act with more advantage.

In fact the turbine is so planned as to satisfy, *practically,* the theoretical condition which the European philosophers have established as necessary to the production of a maximum effect in water wheels, viz: *that the water must enter the wheel without shock, and leave it without velocity*—or in other words, that it must be a wheel of pressure and not of impulse—which condition, fulfilled by the turbine, is not satisfied, but reversed by the reaction wheel; and hence it is that the latter ranks amongst wheels of impulse, and has an effective co-efficient of only about 0.400, whilst the former takes its place amongst the wheels of pressure, and has a co-efficient approximating to 0.800, or double that of the other.

In fine, if we may be allowed to make such a comparison, turbines are horizontal *overshot wheels,* and reaction wheels are horizontal *undershots;* both being similar in action and effect to these, except that in consequence of the water acting in both, upon the whole circumference at once, under full pressure, they admit of being made much smaller in diameter than overshot or undershot wheels; on both of which the water of the fall acts efficiently only by a part (sometimes a very small part) of the periphery.

Experiments demonstrating the economical value of Turbine Water Wheels.

The first *turbine* established by M. Fourneyron, after he had completed the plan of his invention, was applied to a saw mill at Pont sur l'Ognon, in France, and a series of experiments were there made by him, to satisfy himself concerning its value as a motor; but although these were perfectly satisfactory, he waited with commendable caution, until he had constructed and put in action several other turbines, (all

of which performed well,) before he publicly communicated the results.

Having obtained a patent for his invention in France, he wrote a very able essay which is published in the "Bulletin de la Société D'Encouragement pour l'Industrie Nationale," for 1834, and gives a full description of the invention and of several turbines which he had then constructed; one of them upon a fall of four and a quarter feet, being of fifty horses power. The society above referred to, awarded to M. Fourneyron a prize of 6000 francs for the successful introduction of his wheels into use.

The great advantages possessed by the turbines over other known hydraulic motors, as displayed in their work at various mill seats, soon attracted considerable attention upon the continent of Europe; and in 1837, Capt. Arthur Morin, of the French Artillery, a distinguished experimental philosopher, took up the subject with the view of fixing decisively, the economical value of this motor; and he made a careful, impartial, and prolonged series of experiments upon turbines of large size, which were then driving extensive mills at Müllbach and Mousray, in France.

The record of these trials, with remarks by M. Morin, was published at Metz and Paris in 1838, under the title of "*Experiences sur les Roues Hydrauliques a axe vertical appelées Turbines,*" from this work we have derived most of the facts herein embodied, and it will be found well worth an attentive perusal, by persons interested in these subjects.

About the same time also, M. Dieu, a major of Artillery, made experiments upon the useful effect of a turbine, established in the mill of Lepine, which trials were quoted and reduced by M. Morin, in the work above referred to.

Experiments upon the available power of a turbine, were also tried upon one which was established at St. Blaise, in the Black forest, and actuated by a stream of water having the enormous fall of 354 feet!

Finally, connected with a proposition made by M. Arago, to create a small fall in the Seine at Paris, and employ turbines upon it to supply that city with water, in lieu of other contrivances now existing for that purpose; a commission was appointed by the Prefect of the Seine to conduct a series of experiments upon the turbine of Inval, and they particularly examined the effect of backwater upon turbines, arriving, as the others had done before, at the conclusion that the coefficient of useful effect was not sensibly diminished, even when the turbine was deeply immersed in backwater.

As the writer believes that no experience has yet been had in America, with *turbines* at large, he is unable to quote any experi-

ments made here, upon a working scale; but in this case, any further trials than those made upon the continent of Europe, seem quite unnecessary to establish the value of this machine; for those experiments —made by different individuals, at different periods of time, upon turbines of different size, and actuated by different falls of water—corroborate each other so completely as to fix the value of the turbine, as an hydraulic motor, in a manner so definite and conclusive, as to be wholly beyond the reach of cavil or dispute.

The following table contains a very brief summary of some of the results of the numerous experiments above refered to; M. Morin alone having made 48 separate experiments upon the turbine of Moussay, and 84 upon that at Müllbach.

Situation of the Turbine.	Fall of water in feet.	Volume of water used in a second in cubic feet.	Number of turns made by the wheel in a minute.	Useful effect in horses power.	Ratio of the useful effect to the power; or co-efficient of effect.	Name of the Experimenter.
Moussay,	$24\frac{6}{10}$	26	190	45	0.690	M. Morin.
Müllbach,	12	$88\frac{3}{10}$	60	91	0.780	Ditto.
Lepine,	$6\frac{6}{10}$	$15\frac{1}{2}$	75	$9\frac{1}{4}$	0.772	M. Dieu.
Inval,	$6\frac{1}{4}$ to 1				0.770 to 0.650	A Commission.
St. Blaise,	354	$1\frac{1}{10}$	2300	40	0.800 to 0.850	M. Fourneyron.
Pout sur l'Ognon,	$4\frac{1}{2}$	$13\frac{1}{2}$	50	$5\frac{4}{10}$	0.880	Ditto.

Capt. Morin concludes his account of the valuable experiments made by him, with the following.

General Summary of the Experiments on the useful effect of Turbines.

"From all the experiments that have now been made, which relate,

"I. *To the Turbine of Moussay,* where the height of the fall, during the experiments, was about $24\frac{6}{10}$ feet, and where the wheel was immersed under water about $3\frac{1}{4}$ feet.

"II. *To the Turbine of Müllbach*, where the height of the fall during the experiments, was about $11\frac{1}{2}$ feet, and where the wheel was immersed under water about $2\frac{1}{2}$ feet.

"III. *To the Turbine of Lepine*, where the height of the fall is about $6\frac{1}{2}$ feet.

"IV. *To the Turbine of Inval*, where the height of the available fall was successively reduced from $3\frac{85}{100}$ to $\frac{96}{100}$ feet, whilst on the contrary, the depth to which the wheel was immersed was augmented from $3\frac{3}{4}$ to $5\frac{3}{4}$ feet.

"V. *To the Turbine of St. Blaise*, in the Black Forest, where they used a fall of $354\frac{35}{100}$ feet, with a turbine of $1\frac{80}{100}$ feet diameter, making 2300 turns in a minute, and transmitting a power of 40 horses.

We are able to conclude:

"I. That these wheels are equally suitable to the greatest, as to the smallest falls.

"II. That they transmit a net useful effect, equal to 0.70 or 0.78 of the absolute work, or power, expended by the motor.

"III. That they are able to move at velocities extremely distant, more or less, from that which belongs to the maximum effect, without the net useful effect differing notably from this maximum.

"IV. That they are able to do duty under water at depths from $3\frac{1}{4}$ to $6\frac{1}{2}$ feet, without the ratio of the useful effect to the power, diminishing notably.

"V. That as a consequence of the preceding property, they use all the time, the whole available fall, since we place them below the level of the lowest waters.

"VI. That they are able to receive very variable quantities of water without the ratio of effect to power diminishing notably.

"If we unite to these valuable mechanical properties of the turbines, the advantage that they offer of occupying but little space, of being able, without great expense, and without embarrassment, to be established in such part of the works as we wish, of moving generally at velocities much superior to those of other wheels, thus avoiding gearing or recourse to the transmission of complicated motions, *we conceive, without doubt, that these wheels ought to rank amongst the best hydraulic motors.*"

The striking property which the turbines have of retaining, unimpaired, their co-efficient of effect, or ratio of effect produced, to power expended, even when deeply immersed in *backwater*, deserves further illustration.

Thus from the experiments made upon the powerful turbine at

Inval, which, actuated by a fall of 6½ feet, drives 400 looms at once; it appears that,

With *a fall* of	3¼ feet, and	backwater of	3¼ feet, the	co-eff.	=	0.77
Ditto.	2 do.	do.	4½	do.	=	0.72
Ditto.	1 do.	do.	5½	do.	=	0.65

And M. Fourneyron, in experimenting upon the turbine of Pont sur l'Ognon, found that with the

Wheel *not* immersed	——	and with	$4\frac{3}{10}$	feet fall, co-eff.	= 0.88
Do.	submerged $1\frac{64}{100}$	do.	$3\frac{4}{10}$	do.	= 0.80
Do.	do. $0\frac{82}{100}$	do.	$3\frac{4}{10}$	do.	= 0.87

Other experiments might be cited to the same effect, but that it seems unnecessary to add any thing further in order to establish the important fact, *that backwater does not reduce the co-efficient of effect, appertaining to turbine wheels.*

From the experiments of the French gentlemen, of which the mere results have been already quoted, we may with perfect safety conclude; *that for any fall of water whatever, above a yard high, the co-efficient of the net useful effect, returned by turbines, may safely be assumed at three-fourths of the power expended, whether the site be affected by backwater or not.*

Illustrations of the Utility of Turbine Wheels.

When it is recollected that the first turbine was established at Pont sur l'Ognon, in France, in 1827, that descriptions of several turbines, with authentic accounts of their perfect success, were published in Paris, in 1834, and that the conclusive experiments of M. Morin were made public in 1838, it seems really extraordinary that the turbines have not yet been introduced into, or become known, in the United States; whilst reaction wheels, recommended only by a single one of the good properties of the turbine—that of acting well in backwater—have spread rapidly into every quarter of the Union, although they are very far inferior to the turbine, as an hydraulic motor; and being but little cheaper, must ultimately be superseded by the latter, *in all situations where economy of water is an object.*

That such an advantageous motor, should have been so long neglected by the enterprising people of America, is probably owing, in part, to the fact that the record of those experiments, which have so completely established the utility of the turbine, has been locked up from many in a foreign language.*

* We must observe, however, that some unsuccessful attempts have been heretofore made in the Journal of the Franklin Institute, as well as in some of the English periodicals, to draw from the public that attention to the turbine wheels which they really deserve—thus in this journal for 1839, some extracts were given from the report of the French Aca-

Be that as it may, no more time ought to be lost in fairly testing the merits of these wheels upon this side of the Atlantic; for that they richly deserve the closest attention of the proprietors of any works impelled by water power, will appear manifest from a very few remarks.

In the first place, *they are cheap, and being made of cast iron are very durable;* and the writer, from some examination into this question, is inclined to the belief, that even in the first instance, turbines are not likely to be much *more costly* than ordinary wheels of the same power, whilst they will certainly be much more durable, *and therefore ultimately cheaper.*

Turbines compared with Reaction, Undershot, and Breast Wheels.

Whilst the co-efficient of effect uniformly belonging to the turbine, under all circumstances, approximates to 0.800; this value in undershot, reaction, and breast wheels, is only about 0.400 for the two former,* and say 0.500 for the latter when unimpeded by backwater: and hence the great advantage possessed by the turbine as a motor, when compared with these, is strikingly evident, *as it amounts to* 100 *per cent. over the two former, and* 50 *per cent. over the breast wheel.*

Thus if at the numerous reaction, and undershot mills, now in active use in the United States, the present wheels were discarded, and turbines substituted, by that simple act, at a comparatively small expense, *the available power of all such mill sites would actually be doubled!* whilst in many mills a good deal of gearing between the motor and the working point might advantageously be dispensed with. To make this more clear, if we assume that any given reaction, or undershot mill is now making 40 barrels of flour per day, then, by the mere substitution of turbines for the existing wheels, *the same mill could man-*

demy upon M. Morin's experiments; and in 1840 an article on *turbines*, by G. Rennie, Esq. F. R. S., &c., was republished from Herapath's Railway Magazine, London, 1839; notwithstanding this, not much regard seems to have been paid to them, either in this country or in England, up to the present time; but the writer observes, in the late foreign periodicals, that on the presentation of a paper on "Machines recipient of Water Power," by Prof. Gordon, of Glasgow, considerable interest was manifested at a late meeting of the Institute of Civil Engineers, London, and an animated discussion arose, in the course of which, opinions very favourable to the *turbine* were expressed by some distinguished professional men; and hence it is probable that this valuable motor will soon be introduced into England.

* When, in a previous part of this essay, we stated that reaction, flutter, and tub wheels ranked with undershots, and had like them a co-efficient approximating to 0.400; we meant, of course, in case they were working to the best advantage possible; for it is well known to practical men that as they are usually constructed and used, they consume much more water than the best undershot wheels, or have a co-efficient *often much less than* 0 400; indeed the undershot wheels themselves seldom realize, in actual practice, more than one-third of the power expended, whilst the other wheels of impulse are generally still less efficient.

ufacture at least 80 *barrels in the same time, and with the same consumption of water.*

Again, wherever breast wheels are now in use, with a fixed amount of water available, 50 per cent. may be added to the power of such mills by employing the turbine and discarding the others; thus for example, let us take the well known breast wheels at Fairmount, which supply the city of Philadelphia with water by pumping it from the Schuylkill into reservoirs 96 feet high, above the surface of the Fairmount pool.

These wheels require an expenditure of about 30 gallons of water falling eight feet, to elevate one gallon 96 feet into the reservoirs; or estimating friction, &c., at one-fifth, they have a co-efficient of near 0.500; now by substituting for these, the turbine wheels which possess a co-efficient of 0.750, only 20 gallons falling eight feet would be expended in forcing one gallon 96 feet high, into the reservoirs; or with the same amount of water as is now used upon the breast wheels, if the pumps were impelled by turbines, and the friction remained constant, they would force into the reservoirs, 50 *per cent. more water.*

In this calculation we suppose that the turbines work with only eight feet fall, which in consequence of the impediment presented to the breast wheels at every tide by backwater, we have assumed as the average effective fall now used; but as the turbines *disregard backwater*, it would be proper in employing them to lay them lower than the breast wheels are now placed—indeed if it were convenient to follow the rule fixed by M. Fourneyron, in the supposed case of placing Turbines at Fairmount, they should be laid "just below the lowest waters of summer," *or in the plane of the lowest spring tide.*

Then in consequence of the phenomena displayed in tidal rivers, showing that the tide rises *very slowly* upon the last of the flood, and falls *very rapidly* upon the first of the ebb; it would be found that with turbines laid below low water mark, an average effective fall of about four feet, out of the common tide of six feet, could be made available; or as the clear fall to common high water is now six feet at Fairmount, we should in this manner acquire a mean effective fall of four feet more, or ten feet in all, by taking proper advantage of the ability of turbines, *to act successfully in backwater;* it is therefore unfortunate that these water wheels were unknown at the time the mill buildings were erected at Fairmount, as it would scarcely be practicable now, to gain the full fall without injury to them.

Upon these data if we calculate the effect produced at Fairmount, in gallons raised into the reservoirs, for every 30 gallons now used on the breast wheels with eight feet virtual fall; or supposed to be used

upon turbines with ten feet effective descent, the following would be the *proximate* results.

With Breast Wheels.	*With Turbines.*
Galls. Ft. fall.	Galls. Ft. fall.
30 × 8 = 240 aggregate power.	30 × 10 = 300 aggregate power.
Power. Co-eff. of effect.	Power. Co-eff. of effect.
240 × 0.500 = 120 useful effect.	300 × 0.750 = 225 useful effect.
Deduct friction of the pumps } 1-5th = 24	Deduct friction of the pumps } 1-5th = 45
Galls. lifted 1 foot = 96	Galls. lifted 1 foot = 180
Then 96 ÷ 96 feet height of reservoir, = 1 gallon raised 96 feet by the *breast wheels*, for every 30 gallons expended with 8 feet virtual fall.	Then 180 ÷ 96 feet height of reservoir, = 1⅞ gallons raised 96 feet by the *turbines*, for every 30 gallons expended with 10 feet virtual fall.

In fine, if turbines were substituted for breast wheels at Fairmount, and worked with only a little more fall than is now used, they would by the same expenditure of water, *elevate fifty per cent. more.**

But if it were practicable, or convenient, so to locate turbines there, as to avail of 10 feet virtual fall, they would, with the same expense of water, surpass the breast wheels in their work, (though these are well planned and built,) *about eighty-seven per cent.;* and though with the present buildings the necessary arrangements to realize *the full fall* cannot be easily made, still the above calculation demonstrates the vast superiority of this motor for such sites.

As this mode of illustrating the utility of turbines seems to be well suited to the purposes of explanation, the writer will now make a similar reference to the well known water power derived from the Schuylkill river at Manyunk, in this state, and used there upon *overshot wheels.*

Turbines compared with Overshot Wheels.

Although the co-efficient representing the net useful effect capable of being derived from the expenditure of a fixed amount of water, upon overshot and turbine wheels *is identical,* or approximates to 0.800 in both; still the latter are superior as general motors, owing to

* As the day is not far distant when the amount of water required to feed the breast wheels and their pumps, which now supply the city of Philadelphia with water for use, will equal in quantity the entire summer flow of the Schuylkill river—clear of the leakage of Fairmount dam, and of the amount necessary for the navigation—it must be a gratifying reflection to the citizens that when that day does come, all that they have to do is to resort to the use of the beautiful invention of M. Fourneyron, discard all the breast wheels, and substitute turbines in their stead, *whereby their supply of water will be at once augmented at least one half;* and a resort to auxiliary works at Flat Rock, which have been projected in advance by the able and experienced superintendent of the water works, may thus be postponed for another generation, if not entirely relinquished.

their ability to use, ***or make available, the allowance often made for backwater***, and also to dispense with a great deal of gearing.

Thus at Manyunk, where the head and fall is near 23 feet at ordinary times, it has been deemed advisable, (judiciously without doubt) to throw off, in setting the wheels, ***two and a half feet of the fall as an allowance for backwater;*** and to employ overshot wheels of but about 17½ feet average diameter, working under three feet head; hence the head and fall actually employed is only 20½ feet; now if turbines were used at that place in lieu of overshot wheels, the backwater might safely be ***disregarded***, and thus the entire fall of 23 feet would be made useful, ***or about one-eighth would be added to the power of the mills established at Manyunk.***

Advantages similar to those we have recited, have resulted abroad from the employment of turbines in lieu of other wheels, and such a course will be the result here, for it must be particularly remarked that the turbine wheel is not a merely speculative or untried project, ***but a thoroughly tested and proved machine, about the utility of which, upon the largest scale which practice requires, not the shadow of a doubt can remain upon the minds of any who choose to investigate the subject.***

The turbine wheels possess another prominent advantage which we will now briefly illustrate; thus upon a 23 feet fall such as that at Manyunk, an overshot wheel of 20 feet in diameter, if running at its best velocity of six feet per second at the skirt, would make but six turns in a minute, whilst a millstone, for example, must run about 120 revolutions in that time; hence, such an overshot wheel, if applied to a flour mill, would require gearing in the ratio of 20 to 1, between the motor and working point; but if the turbine were used in such a place under 23 feet fall, it would, when working at its maximum rate of effect, run at least 175 revolutions in a minute, ***requiring no gearing whatever to get up the speed desired;*** consequently a considerable saving would ensue from dispensing with the spur gear, whilst at the same time the power consumed in driving this gearing (which is frequently great) would be saved or reserved for direct application to the work.

In conclusion, the chief points of advantage promised by the use of turbines upon the millseats of the United States, may be briefly summed up as follows.

1. They act with perfect success in backwater.
2. They are not liable to obstruction from ice.
3. They require but little gearing to get up a high velocity at the working point.
4. They use to advantage every inch of fall.

5. They are equally applicable to very high and very low falls.
6. They are equal in power to the best overshot wheels.
7. They may vary greatly in velocity without losing power.
8. They are very compact, and occupy but little room.
9. They may be very accurately regulated, to an uniform speed, by means of a governor connected with the annular sluice gate.
10. They are perfectly simple and not likely to get out of order.
11. They are not very expensive.
12. They are very durable.

These, it seems to the writer, are twelve good reasons, for the adoption of turbines as the motors in all future mills erected in this country—indeed they would fully justify the substitution of them in place of most of the wheels now in use upon our mill seats; for either upon one account or another, the turbine is superior to all other water wheels, *and consequently must be regarded as the very best hydraulic motor now known to mechanics.*

Philadelphia, Sept. 1, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cost of Transportation on Railroads. *By* C. Ellet, Jr., C. E.

[CONTINUED FROM PAGE 233.]

On the Relative Values of Distances and Gradients.

In the preceding numbers I have offered convenient and appropriate formulas for computing the cost of transportation on railroads, and determining the effect produced on that cost by variations in the acclivity of the limiting gradients. I propose now to ascertain the value of any increase or diminution of the length of the line in terms of that grade; that is to say, to determine how many feet per mile the steepness of the limiting gradient may be increased for the purpose of saving one mile of distance; or what increase of distance will be justifiable in the development of a road for the purpose of reducing the line to a level, or of saving any given amount in the rate of ascent of the limiting gradient.

For this purpose we will recur to our formula (B), which expresses the annual charges of the company, and write it thus—

$$\left(2\,C\,\frac{20+x'}{20\,W}\,t' + c\,t'' + \frac{14\,t}{1000} + 500\right)h;$$

in which x' is put for the empirical, or accidental grade, in feet per mile, which it is desirable to relieve; t' the number of tons gross which annually ascend that grade in full trains; t the number of tons net annually transported through the line, in both directions and in full

trains; t'' the number of tons gross carried through the line; C the cost of running a freight engine with its tender one mile; c the additional cost of locomotive power for each gross ton carried one mile, and h the length of the road in miles.

It will, of course, be observed that this formula is applicable only to roads which are used exclusively for the conveyance of freight, and is obtained in the supposition that all the engines are loaded to their maximum capacity on the limiting gradient. But in all lines used for general travel, the passenger trains, at least, and sometimes a portion of the freight trains, are much lighter than the engine is capable of conveying on this grade.

In order, therefore, to express correctly the aggregate annual expenses, *on such lines*, and to render the equation, which it is proposed to deduce, as general as possible, we must add to the above formula the cost of motive power for the number of miles traveled by the engines which are not fully loaded, and the expenses incident to the conveyance of the whole number of through passengers, which are not covered by the cost of power. These expenses have already been stated to be $\frac{p\,h}{100}$, where p represents the number of passengers carried "through;" and if we represent by N' the number of trips made by engines carrying passengers and less than their full compliment of freight, and by C' the cost of running such engines with their tenders one mile, the expression of the aggregate annual expenses, in its most general form, will become

$$\left(C'\,N' + 2\,C\,\frac{20 + x'}{20\,W}\,t' + c\,t'' + \frac{14\,t}{1000} + \frac{p}{100} + 500\right)h; \quad \text{(G)}$$

in which only one of the terms is affected by the value of the grade.

This is a modification of the approximate formula (A), given in a previous number, and is expressed in different terms, though it yields very similar results.

By means of this expression we may readily compare the merits of two lines, of different lengths and grades, and accommodating the same, or different amounts of tonnage, and determine the difference between their values. For this purpose we have only to substitute for the notation the actual values of the gradients, and the lengths of the two lines, and calculate by the equation the annual charges which they respectively involve.

It was from this expression in the simpler state in which it may be presented for application to a road on which the business is restricted exclusively to the transportation of freight, that we determined, in the

preceding number, the sum which might, with propriety, be expended for the reduction of the limiting gradient. But we are not to regard that expression as authorizing a diminution of the acclivity of the gradient, at the expense of any augmentation of distance, unless the value of the increase of the distance be taken into the account. Any increase of the length of the line of the improvement necessarily involves an increase of expense for its maintenance; for the locomotive power which traverses it, and for the cars which pass over the additional distance. The value of this increase of the annual charges consequent on any augmentation $h'-h$ is obviously

$$\left(C'N' + 2C\frac{20+x'}{20W}t' + ct'' + \frac{14t}{1000} + \frac{p}{100} + 500\right)(h'-h); \quad \text{(H)}$$

an expression from which we are able to calculate immediately the annual value of any augmentation or reduction of the length of the road, and consequently the sum which it would be expedient to expend for the purpose of effecting any given reduction.

But we have already seen that if we diminish the inclination of the maximum gradient any quantity $x'-x$ feet per mile, we simultaneously reduce the aggregate annual expenses the amount represented by the expression

$$2C\frac{x'-x}{20W}t'h.$$

In order, then, to determine the change in the length of the line which will have the same effect on the cost of transportation as any given reduction of the limiting gradient, we must equate these two quantities, and deduce from the equation the value of distance, or $h'-h$ in terms of the change of gradient. This operation produces for the expression of the quantity which we will be authorized to increase the length of a road for the purpose of reducing the limiting gradient, of which the ascent is x' feet per mile, down to any other rate x feet per mile,

$$\frac{C}{10W}\cdot\frac{ht'(x'-x)}{C'N' + 2C\frac{20+x'}{20W}t' + ct'' + \frac{14t}{1000} + \frac{p}{100} + 500} = h'-h. \quad \text{(I)}$$

The augmentation of the length of the road adequate to compensate for any given reduction of the limiting grade, is therefore directly proportional to the original length, and reciprocally, or very nearly so, as the power of the engines used in the conveyance of the freight. The greater the tonnage which ascends the limiting gradient, the

greater is the distance that the length of the line may be increased in order to reduce that gradient any given amount per mile; and the greater the power of the engine kept in operation at a given expense per mile run, the less would be the increase of the length of the road for the same purpose. The greater the number of passengers that are carried in light trains, and the greater the proportion of the tonnage which is conveyed by engines loaded below the maximum due to the limiting grade, the shorter must be the line and the steeper the grades. The measure of all these influences is deducible from the formula, which I regard as the true equation of distance. It is expressed in as accurate terms as it is practicable to obtain with our present experience. In course of time the co-efficients may, perhaps, be advantageously modified, to suit the more precise determination of the value of railway constants, which we may anticipate from the increasing facilities which are offered, and the more accurate observations which such facilities will permit.

In order to apply the formulas, we must determine the values of C, C′ and c. Of the two first, C may be estimated, in ordinary cases, at three-tenths of a dollar, and C′ at a quarter of a dollar; and experiment will justify the assumption of a half mill per mile for the average increase of the cost of motive power, due to each gross ton added to the load of the engine—a fact which is expressed by the equation $c = \frac{1}{2000}$ of a dollar. In the formula t'' is put for the gross tonnage of the line, consisting of passengers and freight and the cars which contain both, whether attached to engines conveying full or partial loads.

Let us take the following case for an example. The length of the road, by the preliminary survey, is 30 miles; the limit grade which the eye and judgment have established on the profile, is 40 feet per mile; the anticipated freight is 60,000 tons net, and is likely to be so divided in direction that there will be found an annual gross weight of 40,000 tons ascending this limit grade. The tonnage trains are supposed to be full, and the gross weight of cars, freight and passengers is 130,000 tons. The number of through passengers is 20,000, and the power of the engines intended to be used is adequate to the command of 300 tons gross on a level road. Now,

I. How much would it be good policy to expend in the construction of this road in order to reduce the grade which limits the load from 40 feet down to 30 feet per mile?

II. How much could we afford to pay for the reduction of the length of the road one mile?

III. How much would we be authorized to increase the length of

the road in order to reduce the rate of ascent of the limit grade ten feet per mile?

IV. How much would we be authorized to increase the length of the same road in order to reduce the limit grade ten feet per mile, in the supposition that no passengers are to be conveyed, and that the gross tonnage is all conveyed in full trains, and amounts, exclusive of passengers and their baggage, to 120,000 tons?

Now we have $C' = \frac{1}{4}$; $C = \frac{3}{10}$; $c = \frac{1}{1000}$; $t = 60{,}000$; $t' = 40{,}000$; $t'' = 130{,}000$, and for the fourth problem 120,000; $p = 20{,}000$; $h = 30$; $x' = 40$; $x = 30$, and $W = 300$.

The appropriate quantities being substituted in equation (F) will give, in answer to the first problem,

$$\frac{40{,}000 \times 30 \times (40 - 30)}{600} = \$\,20{,}000:$$

or, it would be worth while to expend 20,000 dollars in grading the road to reduce the ascent of this limiting slope ten feet per mile, providing we do not thereby incur any increase of the cost of maintenance, or any augmentation of distance.

Again, by inserting the values provided by our data in equation (H) we obtain, for the solution of the second problem, in the supposition that the passenger trains make two trips a day, or that $N' = 730$

$$\frac{730}{4} + \frac{3}{5} \cdot \frac{20 + 40}{20 \times 300} \times 40{,}000 + \frac{130{,}000}{2{,}000} + \frac{14 \times 60{,}000}{1{,}000} + \frac{20{,}000}{100} + 500 =$$

2,027 dollars, for the annual charge incident to each mile of the length of this particular road. We multiply this quantity by $\frac{100}{6}$ to obtain the equivalent capital, which we find to be \$ 33,783.

It would be worth about \$ 34,000 to reduce the length of this road one mile.

Again, by inserting these values in equation (I) we will obtain in solution of the third problem

$$\frac{\frac{3}{10} \times 30 \times 40{,}000\,(40 - 30)}{3000\left(\frac{730}{4} + \frac{3}{5} \cdot \frac{20+40}{20 \times 300} \times 40{,}000 + \frac{130{,}000}{2{,}000} + \frac{14 \times 60{,}000}{1{,}000} + \frac{20{,}000}{100} + 500\right)} = \frac{1200}{2027}$$

or about *four-sevenths of a mile.* On such a road, the value of ten feet in the limiting grade is only equal to four-sevenths of a mile in distance, although that grade is not opposed to the heavy trade—a fact which should prompt us to be on our guard when we attempt to reduce the grades of a road by an increase of distance before we have

examined well into the character and amount of the trade which is to be accommodated.

Finally, we shall have, for the solution of the fourth problem,

$$\frac{\frac{3}{10} \times 30 \times 40{,}000\ (40-30)}{3000\left(\frac{3}{5}\ \frac{20+40}{20 \times 300} \times 40{,}000 + \frac{120{,}000}{2{,}000} + \frac{14 \times 60{,}000}{1{,}000} + 500\right)} = \frac{40}{55}$$

or about *five-sevenths of a mile:*—showing that we can increase the length of this road 25 per cent. more, for the purpose of reducing the grade any given amount when we carry no passengers, although the amount of freight is the same, than when the road is destined, in part, for the accommodation of travel. This is simply to say that the value of distance increases with the increase of every part of the business of the line; while the value of a gradient increases only with that portion of the business which ascends it in full trains.

It may be objected to the method which is here pursued that the calculations are predicated on data which are exceedingly difficult, if not impossible, to procure, in anticipation of the experimental result. It is certainly true that such inquiries are not free from some difficulty and uncertainty; and it is also true that the engineer must overcome this difficulty or proceed to his work entirely at random. The values of grades and distances turn upon these facts, and they must either be regulated without regard to any principle, or by these, or some similar equations. The application of the equations will, of course, be somewhat inconvenient, since they compel us to know something about the thing we are doing; they compel us, when we propose to cut down a hill or fill up a hollow, to know what it is to be done for, and to judge how much we shall cut, and when we shall stop. But, however inconvenient it may be to answer such inquiries, it is not the less important to study the subject, and learn how to answer them by some better mode than mere conjecture.

It is unnecessary to make additional application of the formulæ. They are remarkably simple and obvious, and by supplying a ready and convenient mode of comparing different lines, or different locations of the same line, they remove many of the difficulties with which every engineer must have felt himself embarrassed in the exploration or establishment of important improvements. They indicate the proper and only convenient general mode of estimating the aggregate cost of transportation under different assumed quantities of tonnage; and teach us, in the location of a line, the correct value of distance—in the calculation of which the cost of freight is the essential element—and at the same time enable us so to regulate the grades that the transportation may not be improperly embarrassed, and that the com-

pany may not be induced to pay more for the reduction of the cost of freight than the reduction is worth. These are all matters of great interest, and questions which can never be overlooked by an engineer who faithfully performs his duty. Indeed, they must all be met, and maturely considered, at every step of his progress, or the work which is placed under his professional charge will be found to be a failure, and in all probability soon pass into the hands of assignees, or come under the hammer of the Sheriff. They are always objects of immense consequence in the decision of the great questions of general location, which arise in determining the proper routes for railroads of great extent, passing through districts where different lines, having various pretentions, are presented, and where the comparisons of distances, grades, and elevations are of constant occurrence. They are also important where no such general choice is presented, in determining on the details of the location of every line. A road is scarcely ever surveyed on which there is not found some one gradient which controls the average load of the engine, and which it is desirable to reduce.

The first point to be determined, in all such cases, is the probable amount of trade to be transported. This is the leading fact which should govern all the arrangements which are to be made with a view to its accommodation; and the one which has probably elicited the least attention of all in the construction of the railroads, great or small, of this country. There are some lines which were apparently intended for the accommodation of immense quantities of freight, in the design for which no computation was ever instituted for the purpose of ascertaining the probable amount of the trade, or the sum which that quantity would authorize the company to expend for the purpose of removing given obstructions; and there are others on which the actual tonnage is so small that the directors have yet been ashamed to name it to the public, although, in the construction of their road, they permitted arrangements to be made for its accommodation, on a scale of magnificence which could hardly have been justified in anticipation of the trade of India. More labour has been expended in the transportation of materials for the construction of many roads than would have been required to effect the transportation without them of all the tonnage which they are destined to transmit, for all time to come.

There is, accordingly, no return received for the absorbed capital: these works are failures, and they have failed in consequence of the disrespect of the parties by whom they were destroyed, of the first principles which should control every application of machinery to economical purposes—viz. *to make the power proportional to the duty to be performed—and to expend no more money for any object than the value of the object will warrant.* Had this simple maxim

been kept constantly in view in the prosecution of the enterprises which, in this country, have characterized the last twelve years—and been made the test of every plan and every arrangement—there would have been no ruined companies, no railroad auctions, and probably no failures.

In discussing the important questions incident to this subject, the object has been to obtain fair average values of the points at issue, and to deliver the results of the investigation as free from algebraical expressions as is consistent with the necessary accuracy. In this view several quantities, of subordinate consequence, have been overlooked, and the investigation is made to turn upon the essential considerations which rule the result. And this is sufficient; for it is in vain to hope for the attainment of perfect accuracy in questions of this nature, where much uncertainty always prevails in the determination of the value of the data; and the solution which comes within 10 or 15 per cent. of the truth possesses all the accuracy that is necessary to insure the requisite confidence. It is not to *such* errors that companies may trace their destruction; but to the utter and entire disregard of all the essential quantities, circumstances, and considerations, on which success was dependent.

The ruling fact, which ought to control every movement and every plan, is the number of tons to be conveyed one mile. This quantity is made up of the absolute tonnage and the length of the line. If a locomotive engine of 50 horses power be capable of conveying the daily trade on a road 50 miles long, it follows that an engine of five horses power will be adequate to the conveyance of the same tonnage on a road five miles long. And if an engine of 50, or any other number of horses power is able to accomplish the whole labour required on the first road, the same engine will be occupied but *one hour out of ten* in doing the work of the second road. The shorter road, therefore, requires less power—engines of less weight—rails consequently of less strength—and admits, as we have seen, of steeper grades.

In short, *the number of tons to be carried, and the distance which it is to be carried, control the grades, establish the location, and determine the power; the power required fixes the weight of the engine which supplies it; the weight of the engine rules the strength of the rail by which it is supported, and the strength of the rail limits the weight of the car and its load.*

There are certain obvious relations between the duty to be performed by the road and the capacity of the improvement, and the power of the machinery to be applied on it; and if these relations be not respected, both in the general design, and in all the detail, it can only be by sheer accident that the enterprise is successful.

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Memoir Descriptive of the Explosion of the Boiler of the Steamboat Medora, in the port of Baltimore, in 1842; embodying all the leading facts which could be collected on the spot, and accompanied by some suggestions concerning the general construction and management of Steam Boilers. By Benjamin H. Latrobe, Civil Engineer.

To the Committee on Publication:

Gentlemen,—I regret that several causes have concurred to make the memoir of the explosion of the "Medora," requested of me in your letter of April 27th, and promised by me through my friend Mr. E. Morris, so late in its forthcoming, especially as I find that it must be, after all, but a brief sketch of the disaster. I have been unable to gather much other testimony than that which has appeared in the papers; most of which is but little to be relied on, coming, as it did, from witnesses either interested in disguising the truth, or incapacitated by the awful circumstances of the accident, from correct observations, or relation of the facts. The history of the occurrence is shortly as follows.

Upon the 14th of April, 1842, the Medora, a new steamboat, built by a company, to run between Baltimore and Norfolk, was prepared for a trial trip down the Patapsco. She lay at the engine builder's (John Watchman) wharf, on the south side of the Basin. Her fire was lighted at about 2 o'clock P. M., and about an hour after, the agent and some of the proprietors came on board, and she prepared to start. There were probably between 50 and 100 persons in her when she started, many of whom were workmen connected with her construction, and, as on such occasions, these persons, each deeming himself to be "magna pars" of the affair, are prone to intermeddle; there was much crowding and confusion about the engine, and its proper management by the engineman was not unlikely to be interfered with. The pride of the workmen in the expected performance of the boat would naturally dispose them to do all they could to accelerate her speed, and the suspicion afterwards expressed, that undue means were employed to increase the pressure of the steam, was not unreasonable. It has also, indeed, been supported by sufficient testimony; though at the same time contradicted, I am told, by one of the surviving witnesses of the calamity.

The boat had just cast off her lines, and in backing out, had made one or two revolutions of her wheels, when her boiler burst. Five and twenty persons on board, were killed or mortally wounded; the

upper, or promenade, deck over the boiler, was blown in fragments into the air, and the forward part of the hull so shattered that she immediately sunk in ten or twelve feet water. Her engine, except in its connexion with the boiler, and the after part of the hull, was uninjured. The accompanying drawings, by their dotted lines and shaded parts, exhibit the form and position of the boiler before and after the explosion. It was placed forward of the wheel houses, standing fore and aft, in the hold of the vessel, and rising up through the main to within three or four feet of the upper deck. The boiler was thrown upwards to the height of the top of the engine beam, or more than thirty feet, and, while in the air, it turned, so as to fall upon its side, exactly crosswise of the boat. Circumstances connected with the escape of the steam and water, and the resistance of the wood work of the upper deck, no doubt caused this singular rotation.

The boiler, (see figs. 1 to 5, Plate I,) consists of a cylinder eleven feet in diameter, and nineteen feet long, supported on three legs, A, B, C, of the same horizontal length, and composed of sheets five and a quarter inches apart, connected, as usual, by staybolts. The side legs, A and C, are about seven feet, and the middle leg, B, two and a half feet high. To admit the water into these legs, the cylinder, or belly, of the boiler is cut away by rectangular apertures at frequent intervals. The lower half of the cylinder is occupied by forty-seven tubes, eight inches in diameter, through which the smoke and flame are returned forwards, from the chamber at the back of the boiler, towards the chimney in front. Between and above the rows of tubes, were round tie rods three-fourths of an inch diameter; horizontal and crosswise to the cylinder, but similar rods could not be introduced vertically between the tubes on account of the spaces between them not coming in a line over each other. Thus the top and bottom of the cylinder were not stayed by direct ties connecting them in the position of chords—but the top angles at either end of the boiler were braced by diagonal bars and rods, as shown by fig. 5, and above the tubes were one or two rows of longitudinal rods of one inch diameter, going from the forward to the after head. The sheets of the boiler were of the *usual* thickness of one-quarter of an inch, and do not appear to have been of bad quality. There were two fire doors in front, for the introduction of the fuel into the spaces between the legs, see fig. 4; and in the sheet iron composing the front of the smoke chamber supporting the chimney stack, there was a small, movable, circular door opposite each tube, for the insertion of an instrument to clean the flues, when required. The number of gauge cocks was *four*, the lowest being a little above the level of the highest row of tubes. The safety

valve was placed upon a drum near the top of the boiler, and was, as will be seen hereafter, of large dimensions.

Such was the boiler in all its parts; and its unusual size and bold design, must be striking to every observer.

An examination of the wreck of the boiler, as it still stands in the yard of Mr. Chas. Reeder, engine builder, and as it is correctly exhibited in the several views presented in the drawings, clearly shows that it first gave way where the legs unite with the belly, and where the removal of so much of the metal reduced the strength of the cylinder to its minimum. The explosion was *downwards*, carrying away the right hand or starboard leg, and the middle one (see figs. 3 and 4,) and tearing into shreads the inner sheet of the larboard leg, (see fig. 5,) at its junction with the cylinder. The escape of the steam and water, principally on the starboard side, probably caused that side to revolve vertically in the rise of the boiler into the air, and thus would have made it fall upon its larboard side in the descent, while at the same time a horizontal revolution was effected by the forward rush of the expelled fluid towards the angle made by the front and starboard side, this part of the front appearing to be pushed outwards. The boiler evidently fell first upon the hind and upper larboard corner, which is seen to be much crushed, while the explosion operated most powerfully on the front and lower starboard corner. These two corners are diagonally opposite to each other, and this circumstance may account (in connection with the entanglement of the boiler in the fragments of the upper deck,) for the rotation. As the boiler lay in the hold on its larboard side after the explosion, the starboard and middle legs, together with the portions of the cylinder between them, were not entirely detached, but were so far bent backwards, and curled over, as to embrace the circular top, and previous to the raising of the boiler out of the sunken hull of the vessel, they had to be separated by the chisel along the ragged lines *f*, *g*, (fig. 3.) The cutting of the apertures over the legs, in the manufacture of the boiler, to admit the water into them, left the segments of the cylinder, between the legs, united only by the strips of sheet metal remaining, and of these strips, as seen in figs. 3 and 5, not more than one half the original number are left, the rest being carried away by the explosion. The other injuries received were partly due to the rupture and partly to the fall of the boiler, and the numerous and extensive rents manifest the insufficiency of the opening first made, though large, to vent the confined fluid, and that the destruction once begun proceeds, ad libitum, as in almost all similar cases.

Description of the Drawings, which exhibit various views of the Boiler of the Medora after its explosion.

The drawings from 1 to 5, inclusive, are by a scale of four feet to the inch.

Fig. 1 is a view of the *larboard side* of the boiler.

a, the *four* gauge cocks.

b and *c*, rents in the side of the boiler, where the rivets are torn out.

d, *d*, *d*, other rents.

e, place of the safety valve.

f, corner upon which the boiler pitched after being projected in the air by the explosion; and within the crumplings of the iron at this corner, a piece of timber, torn from the deck, was still inclosed, when this drawing was made.

Fig. 2 is a view of the *back* of the boiler.

a, the man hole.

b, *b*, *b*, holes left by fragments blown out in the explosion.

Fig. 3 is a view of the *starboard side* of the boiler.

a, *a*, holes cut by a chisel.

Fig. 4 is a view of the *front* of the boiler.

d, *d*, the fire doors for the admission of fuel.

The 13 tube holes shaded darkest have their tubes still in them, the remaining tubes have been removed since the explosion, but were uninjured by it.

Fig. 5 is a *vertical section* through the length of the boiler; the dotted lines, in this and fig. 2, showing the original outline of the boiler, the water legs, &c.

a, the back smoke box.

b, the front ditto.

Fig. 6 is a *general sectional view*, showing the position of *the boiler* and of the chief parts of the machinery. Drawn by a scale of 30 feet to the inch.

The construction of the boiler, and the manner of its destruction, having been thus described, I proceed to estimate its strength from the data I have procured, together, and in comparison, with the probable pressure of the steam at or near the time of the explosion, and to state the facts of which I received information, respecting some of the circumstances of the accident, accompanied by such remarks as have suggested themselves to me in regard to its causes and effects.

The weakest part of the boiler, to which the calculation must evidently be applied, was manifestly the part of the cylinder immediately over the legs, where the continuity of the sheets was interrupted by

the apertures made in them to let the water down into the legs and promote its circulation throughout the vessel. One half of the strips of iron left between these apertures has been carried away, and the measured width of those that remained is irregular; but there is enough to show that the united breadth of all the strips did not exceed that of the spaces between them, so that the boiler was not more than half as strong over the legs as elsewhere, ceteris paribus. Thus in every twelve inches of the length of the cylinder there were but six inches of sheet iron to unite the segments separated by the legs. A further reduction of strength in the connection of these segments was again made by the occurrence of seams in the strips, depending on rivets, and weakened by the holes punched for their insertion. Now the strength of a joint of this kind will depend upon the resistance of the rivets, and also on that of the remaining iron of the plates which they unite; which resistances should manifestly balance each other, to give the maximum of strength to the joint. The plates may be separated in three ways. 1st, by cutting off, or tearing asunder the rivets, or tearing off their heads. 2nd, by splitting and tearing out the metal between the rivet holes and the edge of the sheet. 3rd, by tearing off the sheet iron between the holes, and in a line with their centres. That it may be indifferent, so far as dimensions are concerned, in which of these three ways the joint may separate, there must be certain fixed proportions between the diameter of the rivet, (the head of which we will suppose to have always such an excess of strength as to make the shank of it give way first,) the clear distance between the rivet holes and the edge of the plate, and the clear distance between the holes themselves, the thickness of the sheet being of course a constant element. Let us now see whether, in the riveting of the sheets of this boiler, the correct proportions were observed—1st, the rivets are eleven-sixteenths of an inch in diameter, and each has a transverse sectional area of 0.375 of a square inch, and, there being three rivets to every *strip* of six inches wide, the whole area of the rivets will be 1.125 square inches. 2nd, the line of metal left between the holes will be (6 — 2.062) = 3.938 inches wide, which multiplied by one-fourth of an inch, (the thickness of the sheet,) will give an area of 0.985 of a square inch. 3rd, the clear distance of the holes from the edge of the sheet, is one and a quarter inch, which, multiplied by one-fourth of an inch, gives an area of 0.312 of a square inch and for the three holes a total area of 0.936 of a square inch. The three resistances appear thus to be somewhat unequal, that of the rivets being the greatest by 14 per cent. of the strength of the metal between the holes, and 20 per cent. of that of the metal between the holes and the edge of the sheet. But when it is recollected that in the first case

the rivet loses part of its whole strength by the strain it suffers in cooling, after being headed in a heated state, and that in the third case the tearing out of the metal involves more than the mere separation of the area of resistance, inasmuch as to permit this, the metal must be considerably bent on either side of the line of rupture through which the rivet makes its way out, and as furthermore, the *friction* of the lapping surfaces of the plates augments their opposition to a separation by sliding on each other, it would seem as if the three resistances were very near to a practical equality, and that the sizes, numbers, and positions of the rivet holes were about what they should be, for the required equilibrium between the parts of the joint. Other boilers which I have examined show a similar adjustment of parts in the joints, so that general practice would seem to accord with the conclusions of the present calculations. An inspection of the manner in which the plates of the Medora's boiler separated at the seams, showed that, in most instances, the metal between the rivet holes and the edge of the sheets, gave way by tearing out, leaving the rivets and intermediate metal uninjured, and this consists with the preceding estimate which makes this element of the joint the weakest of the three. Inasmuch, however, as they approach so nearly an equality of strength, and each may occasionally give way before the others, it may be as well to take the *average* of their resistances for an expression of the strength of the joint, and this should be $\frac{1.125 \times 0.985 + 0.936}{3} =$ 1.015, or say one square inch of metal for every twelve inches (six inches of strip and six inches of space) in the length of the boiler, one-twelfth of a square inch, per running inch of the same; and this is the measure of the strength of that part of it over the legs. Now the elements of the calculation to determine the strain that a cylindrical vessel will bear, from the outward pressure of an elastic fluid, consists of the diameter of the cylinder, the thickness of the material composing it, and the modulus of the strength of that material. Thus if D be the diameter of the cylinder, t the thickness of the iron (both in inches,) P the average force in pounds that will tear asunder a square inch of boiler iron, and x the steam pressure per square inch on the boiler sufficient to burst it, we have the equation $D\,x = 2\,P\,t$, where $x = \frac{2\,P\,t}{D}$. Now D = 132 inches—P = 55,000 lbs. $t = \frac{1}{4}$ of an inch. Consequently $x = 208\frac{1}{3}$ lbs. which would be the pressure of the steam per square inch required to burst the boiler, if it were a continuous hollow cylinder without seams or joints to reduce the quantity and resistance of the metal composing it. But this is not the case in any boiler. The joinings if the plates, if there were no holes

in the boiler, would necessarily reduce the strength to about two-thirds of the entire strength of the sheets, were it not for the support they yield each other at the *laps*, where they are doubled upon each other. In the Medora's boiler, it is seen above, that for every twelve inches in the length of the cylinder over each leg, there is but one square inch of metal resisting rupture, instead of three square inches, which there would be if there were no rivet holes, or spaces, between the strips of iron. So the strength of the boiler over the legs is reduced to the one-third of its full strength in other places, where there are no seams, or perforations; consequently, we must divide the value of x, as above obtained, by 3, to get the real pressure, per square inch, that the boiler was capable of sustaining. Then $\frac{208-33}{3} = 69.44$ pounds per square inch, the utmost strain that this boiler could have borne, without giving way at this, the weakest place. The pressure here spoken of, is of course the *effective* pressure, or the excess of that of the steam over that of the atmosphere.

Let us now proceed to estimate the pressure which could have been produced upon the boiler of the Medora by loading the safety valve to the utmost with the weights which were *attached* to it, and intended so to be used, when occasion should require the maximum pressure, considered by the engine builder to be safe. The diameter of the valve was 15¼ inches at the bottom, with a mitre of 1¾ inches, making its top diameter 17 inches. The levers of the valve were of the second order, and two in number. The primary lever, operating immediately on the valve, had a total length of 35 inches, and from the fulcrum to the centre of the valve disk, was 12½ inches, making a ratio of $\frac{1}{2.8}$. The secondary lever, operating on the end of the primary one, had a total length of 67 inches, and from the rod connecting the two, to the fulcrum of the former, the distance was 10 inches. There were two weights, of cast iron, on the secondary lever, the largest, nearest to the end of it, weighing (by estimate) 200 pounds, and the smaller 56 pounds. When these two weights, which slid as usual on the arm of the lever, which they were perforated to receive, were in contact, and pushed out to the end of the lever, the distance of their centre of gravity from the fulcrum of the long lever, would be 57 $\frac{6}{10}$ inches; so that the ratio of this lever would be $\frac{1}{5.76}$ and the ratio compounded of those of the two levers $\frac{1}{5.76} \times \frac{1}{2.8} = \frac{1}{16.128}$. If the area of the valve be calculated, from its mean diameter,—viz: $\frac{15.25+17}{2} = 16\frac{1}{8}$, it will be found $= 204\frac{2}{10}$ square inches. Then the

extreme pressure which the attached weights could produce upon the safety valve would be equivalent to 256 lbs. $\times$ 16.128 = $4128\frac{77}{100}$ lbs., or, per square inch of the valve = $20\frac{32}{100}$. This is exclusive of what is due to the weight of the valve, and its rod and lever, which may be estimated as follows: for the valve itself, without leverage, 100 lbs.; for the short, or primary, lever, 20 lbs. $\times \frac{17.5}{12.5}$ (the leverage of its centre of gravity) = 28 lbs.; for the connecting rod 10 lbs. $\times \frac{35}{12.5} = 28$ lbs.; for the long, or secondary, lever, 56¼ lbs. $\times \frac{35}{12.5} \times \frac{33.5}{10} = 536$ lbs, being in all 692 lbs. *at the seat of the valve:* and this will increase the whole pressure there to $4820\frac{77}{100}$ lbs., or to $23\frac{6}{10}$ lbs. per square inch of the valve and boiler.

This appears to be the highest pressure which could be brought upon the boiler by the system of weights and levers belonging properly to the valve.

The strength of the boiler, in its weakest places, being then estimated, as above, at $69\frac{44}{100}$ lbs. per square inch, amounted to just three times the extreme pressure which the engine builder appears to have intended it should be called on to bear, and in proportioning the strength of his work to the duty it was to perform, he would seem to have been sufficiently prudent. How, then, did the boiler explode, when guarded by a safety valve of such ample dimensions, designed to give way at one-third of the bursting strain?

That the free action of the valve must have been interfered with, would be a natural conclusion, and is corroborated by the testimony of one of the assistant enginemen, as will be presently mentioned. That the valve had been before loaded to produce a pressure greater than the limit prescribed by its own construction, may be inferred, indeed, from the statement of Mr. Watchman himself, who says, in his examination before the *Coroner's Inquest*, that the evening before the accident, the boiler was tried, and the valve raised with 27 inches of steam, or 27 lbs. per square inch, *as he had calculated*, and that on the previous Saturday, also, the boiler had been tried, and 31 lbs. per sq. inch put on. The lowest of these pressures being $3\frac{4}{10}$ lbs. per square inch beyond the above estimated extreme of $23\frac{6}{10}$ lbs., auxiliary means must have been employed to increase the steam pressure on the trials referred to, but as Mr. Watchman is silent on this point, and also as to the mode in which he arrived at the pressure, whether from an inspection of the mercurial gauge, or a calculation of the proportions, &c., of the valve, it cannot be known whether his calculation conflicts with the one I have offered. He says, furthermore, that about

half an hour before the explosion, he observed the gauge to show 10 inches of steam, and that he then tried to lift the safety valve, *but could not;* and after examining the rope attached to the valve lever, to see if it was on the pulley, he walked away. The result of this examination of the rope he does not state, but he seems to have had fears that some improper means of keeping down the safety valve had been used. That he should not have taken more pains to verify these fears, may well excite surprise. A very short time before the explosion, he says he was told by the acting engineman that the gauge showed 22 lbs. per inch of steam. Another witness says that when the weights were pushed out by him on the long lever, as far as they would go, the steam pressure was 22 inches by the gauge, having shewn 20 inches just before, and that by order of the acting engineman, he then put on *additional* weight, (how much he does not say,) and that two or three minutes afterwards, the boiler blew up. Another witness says that about the time the agent came on board, (some say 25 or 30 minutes before the explosion,) the gauge stood at nine inches.

This testimony agrees in showing that the pressure a half an hour before the accident, was 9 or 10 lbs. per inch, and that just before the boiler burst, it had risen to 22; higher than this it was not observed, except by a person who states that he saw the gauge-stick run up to the deck over it, immediately before the explosion. The evidence, also, of the witness "who put on the additional weight," that the pushing out of the weights *belonging to the valve*, as far as they would go, created a pressure of 22 lbs. per square inch, is confirmatory of the above estimate of the extreme pressure ($23\frac{6}{10}$ per square inch) which those weights were capable of producing, the difference of $1\frac{6}{10}$ lbs. being accounted for by the consideration that the elasticity of the steam would not instantly rise to an equilibrium with the increased pressure imposed by pushing out the weights, and that before the witness could observe whether the valve blew at $23\frac{6}{10}$ lbs. per inch, he had charged it still further with *extra weights*. That any extraneous means were employed to keep the valve down, has been denied by another witness, as I am informed, and have stated before; but the probabilities of the case are so much on the side of the positive declaration of the first witness, that an inquiry into the relative credibility of the two seems unnecessary. It being admitted, then, that new weights were added to those proper to the valve, the next question is, what must they have amounted to, in order to produce the explosion? The compound *leverage* of the valve is, as shown above, $\frac{1}{16.128}$ and its area, $204\frac{2}{10}$ square inches. The extreme pres-

sure it could bring upon the boiler, by its own weights, was $23\frac{6}{10}$ lbs. per square inch. The utmost pressure that the boiler could bear, is estimated at $69\frac{44}{100}$ lbs. per inch. Weight enough to raise an additional pressure of $45\frac{84}{100}$ lbs. per square inch, must then have been attached to the end of the valve lever, and, in order to effect this, the new load must have amounted to 580 lbs. Now it seems very unlikely that a weight, or weights, of such size or number, were in fact hung upon the valve lever, as that could scarcely have been done without detection, and it was manifestly intended to be a concealed act on the part of those engaged in it. The extra stress upon the valve, necessary to cause explosion, was then, most probably, produced by another mode than the suspension of weights from the lever—such as tying it down by its cord, or bracing it down by a strut between it and the upper deck—notwithstanding the averment of the witness, who may still have added new weights, but only to the extent of a part of the required surplus pressure, leaving the rest to be effected by other means applied by other hands. No matter however in what way the valve was kept down, so that it raised, as it did, the pressure to the explosive height, whatever that may have been.

But the boiler may have been in fact weaker than it has been estimated, from a deficiency of strength in the iron of which it was made, and which has been assumed at 55,000 lbs. per square inch. The numerous experiments that have been made upon the strength of this metal (of which those recorded in the Journal of the Franklin Institute, vols. xix and xx, 2nd series, are the most extensive and satisfactory that I have seen, and also the most applicable to the present case, as they were made upon boiler iron,) show that its cohesive power as often exceeds as it falls short of that measure, which may be taken as a fair average. If the iron of the Medora's boiler was, in fact, of bad quality, it may, however, have possessed a tenacity far within that just given; but it scarcely could have descended as low as the one-third of 55,000 lbs., or to 18,000 or 19,000 lbs. per square inch, which it must have done to have yielded to the steam pressure of $23\frac{6}{10}$ lbs. per square inch, supposing the preceding estimates of strength and pressure to be correct. My examination of the iron, as it appeared on the torn edges of the sheets, did not impress me with an unfavorable opinion of its quality, although it showed the distinctly laminous structure which most sheet iron exhibits. Its strength in the ruptured parts could not have been diminished by over heating, for those parts were far under the lowest level to which it is in the least degree probable that the water could have fallen, even had it declined below a safe and proper height. Moreover, the *strips*—the giving way of which caused the bursting of the boiler—were so situated that the fire

could not have been at all in contact with them had the boiler been *dry*, as they occupied the spaces over the legs, and, consequently, must have been always immersed either in water or steam. There is, however, no evidence that the water was deficient in quantity at the moment of explosion; on the contrary, many witnesses declared that the gauge cocks showed a full supply, and, considering the vast size of the boiler, the shortness of the time between the lighting of the fire and the occurrence of the explosion, it seems not likely that the evaporation could have sunk the water to a dangerously low level, if, as is to be supposed, it was properly filled at first. I could, indeed, discover no trace of injury to any part of the boiler by burning of the metal, and my examination of the uppermost tubes, and the top of the back smoke chamber, was very careful, and if these parts of the boiler *were* overheated, they, nevertheless, stood firm, and left the rupture to take place elsewhere. No incrustations likely to impede the transmission of the caloric to the water, and thus render the iron liable to burn, anywhere appeared, and were not to be expected in a perfectly new boiler. The degree of heat imparted to the parts of the boiler covered with water, would not, at all events, have exceeded the temperature due to the effective pressure of about $4\frac{3}{4}$ atmospheres, or $69\frac{44}{100}$ lbs. per square inch, which has been above estimated as sufficient to burst the vessel. This temperature (see Journal of the Franklin Institute, vol xvii, page 291, 2nd series,) is not more than 300 degrees of Fahrenheit, and the experiments recorded in the same Journal (vol. xx, pages 24 to 31, 2nd series, and curve-traced in plate X,) show that the tenacity of iron is *increased* by heat, until a temperature of at least 400 of Fahrenheit is surpassed, when it begins to diminish. The boiler, then, could not, in my opinion, have burst from overheating the metal *in the parts where the rupture actually took place*—to wit, in the strips over the legs, uniting the segments of the cylinder between them. In estimating the strength of these strips, I have supposed, from inspection and measurement of those that remain, that they contained one-half of the original quantity of metal in the sheets, which was further reduced to one-third of that quantity by the rivet holes. In this estimate there is room for mistake, and, possibly, I may have in this assigned more strength to the boiler than it in fact possessed. In both the quality of the iron and the amount of metal in the strips, then, there may be room for considerable reductions upon the preceding calculations of the ability of the boiler to withstand the pressure of the steam. Again, although the metal did not, on account of its greater strength than that of the strips, give way where, if at all, it must must have overheated—viz: in the top of the smoke box, or in the upper flues—there is a possibility that these parts

may have been laid dry by the falling of the water, and have become so hot as to generate suddenly a larger body of vapor (or, who knows, an explosive gas,) than the safety valve could vent with sufficient rapidity to save a rupture, even if that had been loaded to less than the strength of the boiler. This supposition is, however, in the face of the *evidence,* though, unfortunately, too little credit is due to such testimony in cases of this kind.

It is stated, by several witnesses, that the safety valve did not *blow* at all while the steam was getting up, and that from the time of making the fire, up to the moment of the explosion, not more than two or three short *puffs* proceeded from it. These would, indeed, suffice to show that it could not have stuck fast in its seat from the action of some adhesive force—an instance of which kind is on record. But it also proves that if, after all, the valve was not overloaded, at least the engineman and his assistants, &c., were strangely indifferent to the unusual absence of that audible evidence of its free action, which always attends the starting of a steamboat.

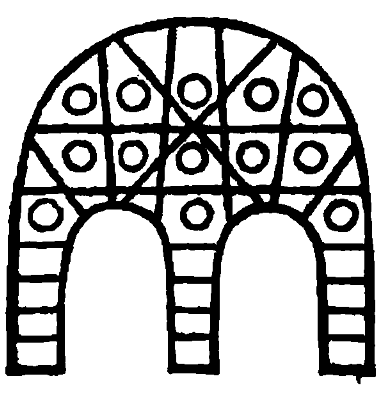
Although doubt must continue to rest upon the true and special cause of the explosion of the boiler of the Medora, and I am not prepared, in relation to that cause, to offer more than the preceding facts and inferences, for the judgment of others, yet some general conclusions may, I submit, be satisfactorily derived from the circumstances of this catastrophe. First—the boiler was too large in its diameter for the strength of metal employed, looking to the risk of bad material and workmanship. The thickness of the sheets was a quarter of an inch—a thickness, by the way, almost universally employed in the construction of steam boilers of all diameters, as if there were some magic in this particular dimension, which made it most pliantly applicable to all cases, however varying. Referring to the formula $x = \frac{2\,P\,t}{D}$ we find that iron one-quarter of an inch thick would require a pressure of 573 lbs. per square inch to rupture it in a cylinder of three feet diameter, (a diameter of usual occurrence in locomotive and other high pressure boilers,) if the modulus of its strength be 55,000 lbs. per square inch, and a deduction be made *for the seams,* of twenty-five per cent. While the Medora's boiler, of eleven feet diameter, and the same thickness and strength of sheet iron, would have borne but 156¼ lbs. per square inch, with a proportional reduction of one-quarter for the joints, (saying nothing of the still greater subtraction of strength due to the apertures over the legs,) can there be any propriety in using the same thickness of plate for each of these widely differing diameters? Yet it is done under the influence of the apparently *prescriptive right* of the quarter inch iron to be employed

in all cases whatever. It is true that the small diameter boilers are high pressure, and subjected to the greater strain, but their excess of strength is, at the same time, vastly greater than that of the large low pressure boilers. The usual high pressure strain is, perhaps, about 100 lbs., and the low pressure strain, 25 lbs. per square inch. The excess of strength in the three feet high pressure boiler is, then, 473 lbs. per square inch, and in the eleven feet low pressure boiler of the Medora, it would be but 126¼ lbs. per square inch. It may be said, indeed, that the ultimate strength of the former is but 5.73 times its usual strain, while that of the latter is 6.25 times its ordinary stress; also, that at the high temperatures accompanying high pressures, a given increase in the temperature causes a more rapid rise in the pressure than at the low temperatures of the lower pressures, so that there is occasion for more excess of strength in the former than in the latter cases, to guard against accidental augmentations of temperature. Also, that the consequences of explosion at high pressures are more disastrous than at those of a lower grade, and should, therefore, be more carefully guarded against. There may be some propriety in the two first of these suggestions, but not so much in the last, as some of the most fatal explosions have occurred in low pressure boilers; and still I think that low pressure boilers, whose diameters are generally from eight to nine feet, are usually too weak when made of quarter inch iron; and this opinion is held á fortiori in regard to the Medora, with her boiler of eleven feet across. Braces are indeed used in these large boilers, but with often only partial effect, and in the Medora, as has been already remarked, they could not be applied in the vertical, or radial, direction, in which they would have done most good, on account of the positions of the tubes.

Second—a boiler of the colossal size of that of the Medora, presents a bold and striking aspect, and seems fitted for the generation of a vast supply of steam; and so, doubtless, was the boiler in question, the fire surface and steam room of which was of unusually ample extent. But the same fire surface will be as effectual if distributed among two or three boilers, and with great increase of security against explosion. The one large boiler will, perhaps, cost less in the manufacture, and occupy less room in the boat, but it will be much more difficult to move, in placing and displacing it; and if accident happens to it, the supply of steam is wholly cut off; while with more than a single boiler, each of which can be insulated from the other, it may be kept up, and the engine worked at a lower speed, till the injured boiler is repaired.

Third—the design of a boiler resembling the Medora's, is deficient in strength at the junction of the belly with the legs which support it,

and form the sides of the fire-place. The perforations of the cylinder *must* be large enough to permit the water and steam bubbles to pass freely up and down, in the necessary circulation of them through the boiler. *Small* holes over the legs would not allow this; the circulation would be checked, less steam would be generated, and the legs of the boiler become unduly heated for want of the constantly required supply of cold water, which, in a boiler with no obstruction to circulation, is constantly descending towards the fire, from the upper and cooler parts of the vessel—towards which last, the steam bubbles are simultaneously rising to the steam chamber; the two currents thus running contrary to each, without mutual interference, as their very different specific gravities maintain an easy separation between them. Thus the *vertical* has an advantage, in regard to circulation, over the *horizontal* tubular boiler; the tubes of the former interfering much less with the passage of the two counter currents, and its fire-place being at the *bottom* of the boiler, instead of at one end of it, horizontally, gravitation gives more assistance to circulation. The maker of the Medora's boiler was right, therefore, in giving wide passages for water into the legs, but, as to do this necessarily weakened his boiler so much, it shows a faultiness in its plan. It is not, indeed, easy to see why he departed from the usual mode of building boilers of this character by arching the fire-places as in the accompanying drawing, and so arranging his flues as to permit numerous ties in a radial direction across the boiler, connecting the outer shell with the fire-arches, as well as the flues. Here no cutting of holes would have been required, and any degree of strength given without interference with circulation. The ties introduced into the Medora's boiler, are not in the most effective position. A tie, or brace, in a cylindrical boiler, should never, if possible, occupy any other position than that of a perpendicular to the surface, supported by the tie, or brace. Here they are *diagonal* to the ends and roof, and as chords, *less than diameters*, across the cylinder.



Some other obvious remarks suggest themselves, in conclusion, and are generally applicable to steamboats when under trial, on such occasions as this ill-fated vessel was about to begin.

Most of the persons on board the Medora, at the time of her explosion, were, as before stated, workmen who had been engaged in her construction. It was not safe to leave the boat as it *was* left, in the hands of these men, most of them, probably, reckless of danger, by character, and fired with the false ambition congenial to the occasion. The safety valve and mercurial gauge should have been constantly

under the eye of the engine builder, whose machine was being submitted to proof. The valve lever and its attached weights, and the means of moving them, should have been so constructed, and surrounded by guards, as to make it impossible that more than the extreme pressure designed to be put upon the valve, could be applied without doing violence to the defences of the apparatus. The boiler (as should all steamboat boilers,) should have been provided with a small pumping steam engine, to keep up the water, as at such times, especially, the boat has often to wait a good while before starting, the water gets low, and the engineman and his *assistants* (viz: the crowd around him,) are too excited, and anxious for a quick and favorable commencement of the trip, to go to work at the drudgery of pumping up by hand. Frequent trials of the state of the safety valve should be made, and it should not be left to *blow of its own accord* at a safe pressure, but should be raised by force, and the surplus steam permitted to escape. This would prevent the valve from *adhering to the seat*, as it has been known to do, in consequence of the rusting of the iron, or the introduction of some glutinous, or cohesive, matter, thereto. The propriety of these and similar precautions, need not be enlarged upon. It is remarkable, and yet a clear consequence of the laws of mechanical *momentum*, that, in all these explosions, the rents made in the vessel should be so much greater than necessary to vent the steam and water with the rapidity that one would suppose far more than sufficient to relieve the pressure upon all other parts of the boiler than the part *first ruptured*, so much as to save them from injury. While the confined fluid is quiescent, however powerful its effort to escape, it does no harm, except in the preparation it is making to force an outlet, by gradually increasing its strain on the metal until an equilibrium is attained between the two forces of impact and resistance. But the instant that equilibrium is passed, upon a single square inch of the vessel, and the imprisoned fluid begins to put itself in motion, it breaks its way out, in a hundred directions instead of one, and we see parts of the vessel, of extremely unequal strength, giving way at the same moment. Thus in the Medora's boiler, the drawing shows several pieces blown out at the back, which were unquestionably far stronger than the strips of metal over the legs. The sudden escape of the steam and water, also, acting on the sides and bottom of the boat, give to the boiler that projectile force which throws it, en masse, into the air, and inflicts other great injuries in its fall. In all considerable explosions, indeed, the boiler has been more or less *displaced*.

Thus is demonstrated the unsoundness of the opinion that *simple pressure*, steadily increasing, within a steamboiler, ought to open the

seams, as being the weakest part of the vessel, and thus provide a safety valve, for the escape of the vapor. To account for the fact that boilers *never do give way in this manner*, the hypothesis of explosive gases has been paraded with, as I humbly conceive, very little foundation in fact, although rare instances of that description may have occurred, under particular circumstances.

Baltimore, August 2nd, 1842.

To the Committee on Publication:

Gentlemen—Having received the annexed *Official Report* from Major Baker, Commandant of the United States' Arsenal at Watervliet, New York, (where the preservative process has been several years in operation,) I hand it to you for publication, not doubting you will consider it as sufficiently a subject of general interest to entitle it to receive publicity through your Journal.

Respectfully, your ob't serv't,

Edward Earle.

Watervliet Arsenal, June 6th, 1842.

Report of the comparative Strength and Elasticity of Mineralized Timber and that in the Natural State.

To Major R. L. Baker.

Sir:—I have submitted to the proving machine twelve pieces of each kind, comprising oak, maple, birch, whitewood, or tulip tree, and pine.

The principal data recorded were—

1st.—Deflection with the constant weight of 383 lbs., (weight of apparatus.)

2nd.—Greatest deflection and weight while the elasticity was perfect.

3rd.—Ultimate deflection and *breaking weight.* The deflection was also generally taken for every additional weight.

Five minutes were allowed for a *set*, five minutes for *resilience*, and five minutes between each 20 lbs. added near the breaking point.

The proof pieces were 2 inches square, and 48 inches of effective length, prepared in November, 1840, by sawing blocks of large timber lengthwise, into battens, which were carefully finished by the plane to a square of 2 inches, and the weight of each taken to within 3 grains. One half of the battens from each prism of timber were selected for mineralizing, by taking, from a map of the end, every second piece over the whole area. They were mineralized in November, 1840, and since that date both kinds have been constantly in store,

and seem *absolutely dry*, many of them having lost from one-sixth of a pound to one-fifth of their original weight. It is somewhat remarkable that birch has lost less than other kinds, and some pieces have increased in weight from a few grains to more than a pound.

In the oak, pine, and whitewood, the average of the breaking weight was greatest in the mineralized pieces, equal in those of birch, and a little less in maple. Being called to other duty, the number of proofs in maple and birch were too few to be satisfactory; but thus far, the results lead to the decision that Dr. Earle's process *does not reduce the strength* of timber. The elasticity seems a little diminished in several, and perhaps further experiments may show some corresponding increase of strength.

Tabular Comparison.

	Mineralized.		Unprepared.	
	Greatest deflection.	Breaking wt.	Greatest deflection.	Breaking wt.
Oak . . .	2.37	1256	2.06	1226
Maple . .	1.50	1469	1.36	1617
Birch . . .	1.00	808	1.15	1014
Whitewood .	1.55	965	1.95	931
Pine . . .	1.25	729	0.82	589

Two contiguous battens on the map were selected—one cured, the other raw—and each reduced one-eighth of an inch on each face, to remove the part, if any, injured by the heat, and to render them of one size. The cured broke with 1022 lbs.; the other with 988 lbs.

A number of pieces of different kinds of timber were intentionally operated on *excessively*, by *repeated* and long boilings. In *all of these* which have been tried, the strength *appears diminished* in a slight degree.

All my observations, thus far, tend to corroborate the suggestion that *boiling heat is not necessary*, and that long digestion* is important; and, to prevent checking when taken out, that the timber ought to be *cooled in the tank.*

Respectfully submitted,

(Signed) R. M. Bouton.

* By "long digestion" is meant, a more protracted digestion than has been hitherto employed—that is, from one to two, three or more days, according to size, length, and kind of timber; and at a temperature short of the *boiling point*, or at 170 ° to 180 ° Fahr. A *short boiling*, of an hour or two, however, is recommended for timber of great size and length.

E. E.

To the above you will, I hope, permit me to add an extract which seems quite pertinent, from the last semi-annual Report of T. Tupper, Esq., President of the South Carolina Canal and Railroad Company, who has since last year been using this process on the railroad between Charleston and Hamburgh, South Carolina. Referring to a late advantageous purchase of timber for the road, (*at one-half the usual price,*) he says:

"This timber is obtained at a reduced price, as the sap is embraced in the square of the piece, and, consequently, taking a much less tree than when the heart only is retained.

"The advantage of this process will be felt at once in the lower price at which the timber is contracted for, and should it only last as long as ordinary timber, no expense will have been incurred, as the difference in the price of the timber will pay the expense of preparation.

"The timber prepared four years ago, with corrosive sublimate, is still sound, the sap of which has already shown a durability of double that of unprepared wood, and, from all appearance, will be sound when the unprepared is so rotten that it cannot be separated from the earth in which it is buried."

Here is a most important fact ascertained—the effect of corrosive sublimate on the sap-wood of timber—from which President Tupper derives the practical and useful inference that the sulphates of iron and copper—which have been fully ascertained to affect timber in the same manner as corrosive sublimate—must also render sap-wood, at least as durable as the heart is without them, and, by thus reducing the price of timber *one-half*, annihilate the cost of the process.

E. Earle.

Philadelphia, September, 1842.

Sketch of a Self-acting Flash-board, invented by Mr. John Chase, *and now in use upon a Mill-dam at Cabotsville, in the state of Massachusetts. Communicated by* E. P. Huntington.

The diagram below is an end view of a dam, with a self-acting flash-board, on a scale of one-twelfth the size. It was invented by Mr. John Chase, agent of the Springfield Canal Company, Cabotsville, Massachusetts, and is now in use there. Its design is to obtain a permanent additional supply of water in a mill-dam, equal to six inches head, and at the same time to avoid damage from back water, to those using it on the stream above, when it is high. Its cost is about three dollars per foot lineal.

Description of the Sketch.

A, pond.

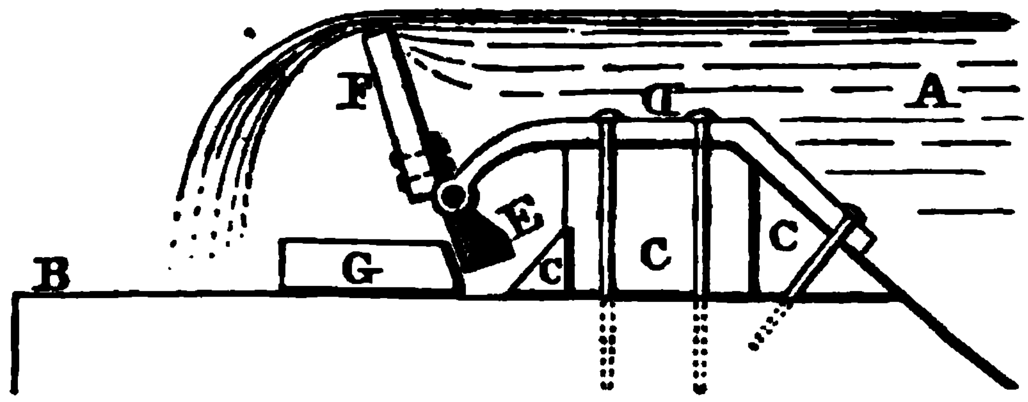
B, top of dam.

C, C, C, timbers spiked on the top of the dam.

D, iron to support flash-board—two to each section of eight feet.

E, bottom part of flash-board of cast iron, made heavy, to counterbalance the weight of water against the top, F, which is oak. Each section is eight feet long.

G, timber which resists the outward pressure of the flash-board, and to which it is hooked when turned down.



By this arrangement, when the water rises to about two inches above the top of the flash-board, the pressure is sufficient to carry the top, F, over to G, and as the water falls, the pressure is less, and it rises—*thus providing a due supply, but never an excess, when the water is abundant.*

Description of a new Self-acting Weir and Scouring Sluice, invented by MR. BATEMAN, *an English Civil Engineer.*

We find in the London Civil Engineer and Architect's Journal, for August, 1842, the following account of a self-acting weir and sluice, brought before the British Association for the Advancement of Science, at their late meeting, held at Manchester.

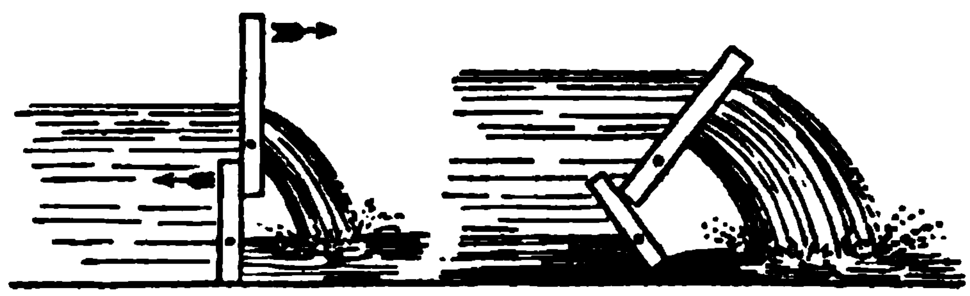
This sluice is an ingenious application to a different use of the same principle of action that is brought into play by Mr. Chase, in the flash-board above described; and it seems to us that upon light streams, Mr. Bateman's invention might often be made a valuable auxiliary to the works necessary for a flash navigation.

Mr. Bateman observed that the great objections to fixed weirs and dams were, that by causing a partial stagnation in the water above them, they allowed the bed of the stream to be silted up by the deposition of mud, gravel, &c., whereas the proposed weir would adjust itself to the various changes in the condition of the stream, and prevent any filling up of the channel by making the stream clear itself.

Mr. Bateman's weir is composed of two leaves, turning horizontally on pivots, which are placed below the centres of the leaves, so that the upper portions of them shall be of much greater area than the lower. The upper leaf is also far larger than the lower, and turns in

the direction of the stream, while the lower leaf turns against the stream, and overlaps the bottom edge of the upper leaf, and is forced against it by the pressure of the water. The comparative area of the leaves and position of the pivots, is so arranged that in ordinary states of the stream, the tendency of the current to turn over the top leaf is counterbalanced by the pressure of the water against the overlap of the bottom one, the counteracting pressures keeping the weir vertical and the leaves closed, the water flowing as usual through a notch in the upper leaf. But when the water rises above the usual level, the pressure above, from greater surface and leverage, overcomes the resistance below, and the top leaf turns over, pushing back the lower leaf, and thereby offering the least possible obstruction to the water, and giving a passage at the very bottom of the stream to the gravel or mud.

The following diagrams will explain the construction of the weir:



In answer to questions and objections, Mr. Bateman explained how difficulties arising from trees floating down, the complete turning over of the leaves, &c., might be obviated by suitable stops, grating, &c. Sir J. Robison observed that the Rotterdam Canal had weirs on a similar principle, but Mr. Bateman explained that those weirs turned vertically on their axis. Mr. Vignoles stated that from the cheapness and apparent advantages of this weir, he hoped it would be brought under the consideration of the Commissioners of the Shannon navigation, and recommended for trial on that river, to which it appeared peculiarly applicable.

Mr. Bateman, in obviating some difficulties suggested, explained that in a weir 20 feet long and five feet deep, which his drawings and model might be supposed to represent, the sum of the closing pressures would be 7956 lbs., and the sum of the opening pressures would be 7669 lbs., the pivots being so placed as to give the areas of leaves, above and below the lines of their axes, the ratio of two to one. The leaves would consequently be kept close by a force equal to the difference between these pressures—that is, 287 lbs. As the water rises these conditions would, however, be changed. Supposing the water to rise one foot, the additional pressure would be 1200 lbs., of which 800 lbs. would be exerted in opening, and 400 lbs. in closing, the leaves; and the result would be, that the sum of the opening pressures would exceed that of the closing, by 100 lbs. The leaves would, consequently, be opened. He also explained that the sills against which the gates are made to close, might be so regulated as to discharge the greatest floods of water without allowing the leaves to open more than a moderate quantity; if thought necessary, however, the gates ought to be allowed to assume a position perfectly horizontal in cases

of high floods, and thereby oppose the least possible resistance to the passage of the water. The sluice might also be protected from being choked with trees and brushwood floating down the stream, by means of a grating.

Franklin Institute.

Address of S. V. Merrick, *Esq., President of the Franklin Institute, preceding the reading of the Report of the Committee on Premiums and Exhibitions.*

Ladies and Gentlemen:

We are again assembled to perform a grateful duty—to mete out the reward to superior skill and ingenuity. This is the twelfth occasion on which this Institute has drawn together the products of American industry; each time with the gratifying result of being able distinctly to mark the progressive improvement of our countrymen in all the arts necessary to the comforts of man.

Those among us familiar with the history and acts of this institution from its formation, and who can trace from step to step the development of the arts, as evinced by its exhibitions, compare with pride and pleasure the display which has now been made with those of former years, and especially that held in 1824, the first experiment of the kind in this country.

At that period, almost the existence of a national manufacture at all commensurate with the wants of the people, was doubted. So great was the prejudice against the American fabric, that the manufacturer who had made any progress towards perfection was, in many cases, obliged to dispose of his products as foreign. The astonishment of the public who were then for the first time made acquainted with the existence of many branches of art which the collection at the Institute opened to their view, and the patriotic feeling which manifested itself, gave a strong impulse to our infant manufactures, and determined the Institute to continue its course, and periodically to collect and display the specimens of art, for the purpose of showing at a single glance the progressive advancement made by the American manufacturer towards perfection.

In these efforts, the Institute has been amply sustained by the skill of the producer, the zeal and industry of its committees, and the liberality of the public.

All parties have appreciated the importance of these periodical exhibitions to our *common* country, and all in their respective spheres have lent efficient aid, and none more so than our fair friends, without whose countenance and support no such enterprize, however worthy, can hope to succeed.

The present exhibition, although not the most extensive which has ever been accumulated under the care of the Institute, is by far the most perfect in most branches of the arts, and evinces so decided an advance towards perfection, as to warrant the belief that the day is

not far distant when all the wants of the community may be supplied by domestic industry.

It is not in the coarser articles only that America is now independent of the foreigner. A glance over this hall will convince the most prejudiced that he need not blush to appear in an American coat. Nor is it any longer necessary to appeal to the patriotism of the ladies for the support of our manufactures. This room will furnish a female attire, from the bonnet to the shoe, which will bear a proud comparison with the products of any foreign country.

The manufactures of our country have taken deep root. The skill, industry, and ingenuity of our mechanics are unrivalled. Let the fostering hand of public opinion sustain them, and the whole community will reap the advantage. "United we stand—divided we fall."

The Report of the Committee on Premiums and Exhibitions, will now be read, with the award of premiums by the Managers. But, first, allow me to tender the sincere thanks of the Institute to the gentlemen of the Committee of Arrangement, who have devoted so much time to this collection and display—to the judges appointed on the various branches of manufacture, to whose prompt attention and impartiality we are indebted for this early award, and to the gentlemen of the public press, who, with untiring zeal worthy of the cause, have daily spread before the public full and judicious reports of all the articles in the saloon. To their liberality and public spirit, the Institute is especially indebted.

Report of the Committee on Premiums and Exhibitions of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, on the Twelfth Exhibition of American Manufactures, held in Philadelphia from the 18*th to the* 31*st day of October*, 1842.

The *Committee on Premiums and Exhibitions* report that, having brought their labors in reference to the awards of medals and certificates to a close, they respectfully present them to the Managers for examination.

The usual arrangements for holding the Exhibition of Domestic Manufactures were made, and the day of opening fixed for Tuesday, the 18th of October. Every endeavor was used to give publicity to the fact that the exhibition was to be held, and that it would be opened on *that* day, in order to avoid the disappointment to depositors resulting from too late a presentation of their deposits, which so frequently excludes them from the examination of the judges and the award of premiums. In all these preparatory steps, a zeal and interest was manifested by the Committee of Arrangement, which was an earnest of the efficient services rendered by them since the opening of the exhibition. These services must, and doubtless will, receive the best thanks of the Managers of the Institute, and of the mechanics and manufacturers generally.

The place of holding the meeting was, after much discussion, fixed at the Museum building. The advantages and disadvantages of the

location—of the change from a suite of many rooms to a single large hall—and all other circumstances bearing upon the question, were fully considered. Notwithstanding that the prepossessions of the visiters must have been in favor of the former place of exhibition, the present locality appears to have given great satisfaction. By a division of the room by tables, for the display of articles, a sufficient length of show surface was obtained, and an extent of promenade afforded which satisfied even the most exacting. From certain points in the room, the general view was very pleasing, taking in at the same glance the numerous and varied objects of art and manufacture which filled the body of the room, and the moving groupes in the intervals engaged in their examination. The facilities afforded for putting the stoves and grates in action, have added much to the interest of one of the most useful branches of the exhibition; and the politeness of the occupants of the adjacent houses, and especially to Mr. Welsh, to whom the thanks of the Managers are justly due, enabled us to occupy a large area exterior to the exhibition hall and directly communicating with it.

There being but one chief hall of exhibition, has given rise to the impression that the number of articles exhibited is very considerably less than on former occasions. This, however, is by no means the case. It is true that the number and variety of the articles, in some particular departments, have not been quite so great as at the last exhibition, but this has been much more than counterbalanced by the choice nature of the specimens produced. In this respect, the present exhibition has surpassed all that preceded it. Notwithstanding the depression in all branches of industry, new fabrics and articles have appeared in many of the departments in useful lines of trade, and with a degree of perfection, and at prices which will secure a market for them.

Where so much merit appears, discrimination is invidious, and indiscriminate notice bears the aspect of fulsome praise. In illustration, however, of their position in reference to the excellence of the exhibition, the Committee would refer especially to the display of cotton, woollen, and silk goods; of stoves and grates, and of new and useful articles of hardware.

The judges have bestowed an amount of attention in the minute examination of the articles submitted to them, which merits the thanks of the Managers, and which should secure the approbation of the depositors. They have left but little more for the Committee to do than to make a compilation and very general revision of their labors. But two of the Committees of judges failed to present reports, most creditable to their authors. Each article, in turn, is commented upon, and the discriminating remarks show the unwearied patience with which these gentlemen have applied themselves to their work. It has been thought, by the Committee, that visitors should have an opportunity of examining the articles to which medals, or certificates of honorary mention, have been awarded. This new feature in the arrangements has required that the reports of the judges should be presented on or before the day when the awards are to be made. Some years

ago, this would have been deemed an *impracticable result* to attain; but the interest now excited by the biennial displays of American ingenuity and skill, has increased; those immediately engaged in their superintendence feel the stimulus, and require merely that this much should be pointed out, to be resolute for its execution. All the reports, with the exceptions before noted, have been received.

In recommending to the Managers the awards, the Committee have, of course, in general, followed principally the indications of the Committee of Judges, exercising only the power reserved to them, that chiefly to make awards in case of special merit to articles which do not come within the lists of the judges. The particulars of the action of the Committee, may be inferred from the introductory remarks to each of the separate heads, or departments, into which the specimens have been classed.

Public attention has been steadily turned towards the present exhibition, and on each day since the opening, with the exception of one, when the weather was unfavorable, the attendance of visitors has been most encouraging.

The loss met with in the robbery of one of the offices for the receipt of money, has rendered every offering acceptable, and the Committee hopes that the community may be induced to remember this as a motive to return frequently, in addition to those of curiosity or interest in the exhibition.

As many of the scholars from the Public Schools, and other institutions, as the convenience of our visitors would permit, were invited to the exhibition, in the hope thereby to encourage early a spirit of admiration of the resources of the great country of which they are one day to be citizens. It was not one of the least interesting parts of the exhibition to see these eager and attentive throngs, passing with regularity and order through the windings of the hall, forming at times a continuous line, nearly from the door of entrance to that of exit.

All the attendant circumstances of this exhibition, with the exception before noted, have been of the most satisfactory character, and show that the system once understood, is readily managed by the Committees, and acquiesced in cheerfully by the depositors and the public generally. The Committee feel gladdened by these results. However toilsome the effort to the members of the Institute, their reward is ample. However troublesome to the manufacturers or mechanics, or to the depositors, their return is certain. All must be gratified in being instruments of public good, and the manufacturer and mechanic, especially, must feel that he has a full recompense for exertion in the sympathy of the public, with the successful efforts of American industry.

The Committee proceeds to pass in review the several divisions of the exhibition, commenting upon them, and stating the awards, which they recommend for the approval of the Board of Managers.

I.—*Cotton Goods.*

This branch of domestic manufactures has steadily and rapidly im-

proved. The exhibition of this year was more remarkable for the excellence than for the extent or novelty of the fabrics. The improvement in printed goods was especially remarkable; a few years since foreign goods supplied our market in this branch almost entirely, now the domestic articles are so cheap, and of such good quality, as almost to exclude the foreign.

In accordance with the recommendation of the judges, the Committee makes the following awards:

To Perkins & Wendell, of La Grange, Philadelphia county, Pennsylvania, for No. 493, consisting of printed cottons, among which the judges specially designate a "light ground London style, and black ground Hibernia chintz," "three-colored stripes, and also rich green ground stripes." A Silver Medal.

To R. Garsed & Brothers, of Pennsgrove, Delaware county, Pennsylvania, for No. 263, deposited by them, cotton and worsted damask table covers, considered to merit a medal on account of novelty and excellence. A Silver Medal.

To James Wright, of Philadelphia, for No. 20, samples of Turkey red yarn, which possesses the qualities of eveness and strength, and has stood the action of chemical tests nearly as well as the imported yarn. A Certificate of Honorable Mention.

While in the opinion of the Committee this article is still inferior to the foreign, they desire to encourage the manufacturer to proceed in his efforts to bring it quite on an equality with the imported.

To Thomas Poole, of Philadelphia, for No. 21, cotton and worsted nett suspenders, remarkable for the smoothness and regularity of the web, and for strength and elasticity.

A Certificate of Honorable Mention.

To B. Starkey, of Philadelphia, for No. 92, quarter plaid ginghams, bearing a close resemblance to the Earlston gingham.

A Certificate of Honorable Mention.

The Committee of judges speak favourably of the work of other manufacturers. Their minute report, together with that of Dr. A. D. Chaloner, by whom the examination of the colors of the Turkey red yarn, No. 20, was made, will be published with the general report of the Committee. The importance of this branch of manufactures would induce the Franklin Institute to give every encouragement and all the publicity in their power, to the meritorious results of those engaged in it.

II.—*Woollen Goods.*

The display of woollen goods was varied, of superior quality, constituting one of the most prominent objects in the present exhibition. In accordance with report of the judges, the Committee has made the following awards:

To Edward Harris, Woonsocket, Rhode Island, for No. 468, deposited by him, merino cassimeres, "showing great skill, and a high degree of improvement in the manufacture." A Silver Medal.

To the Ballard Vale Co., Andover, Massachusetts, for No. 244, deposited by Paul Farnum & Co., consisting of white and scarlet flannels. A Silver Medal.

The judges remark of the specimens, that part of them possess the "unshrinking quality so highly prized in this article."

To the Rochester Mills, New Hampshire, for No. 475, very superior white Mackinac blankets, of remarkably pure and soft wool.

A Silver Medal,

To Duncan & Cunningham, of Belleville, New Jersey, for No. 471, deposited by them, seven embroidered woollen shawls.

A Certificate of Honorable Mention.

To the Middlesex Manufacturing Company, of Lowell, Massachusetts, for No. 488, deposited by Stone, Slade & Farnum, for four pieces of wool black cloth. A Certificate of Honorable Mention.

The judges considered these articles as remarkable for color, finish and quality.

To the Middlesex Company, Lowell, Massachusetts, for No. 488, deposited by Stone, Slade & Farnum, Belgic cord, a new article, in the manufacture of which, much skill and good taste are displayed.

A Certificate of Honorable Mention.

To the Middlesex Company, Lowell, Massachusetts, for No. 488, deposited by Stone, Slade & Farnum, double milled fancy cassimeres.

A Certificate of Honorable Mention.

To Wethered & Brother, Baltimore, for No. 469, double milled fancy cassimeres, to which the judges refer, especially to two pieces, as possessing the elastic property highly valued in French goods of this description. A Certificate of Honorable Mention.

To the Salisbury Company, Massachusetts, for No. 498, deposited by Waln & Leaming, scarlet and white flannels.

A Certificate of Honorable Mention.

The judges also speak favourably in their report of No. 576, four pieces of wool-dyed black cloth, manufactured by W. & D. Farnum, Waterford, Massachusetts, and deposited by them; of No. 470, white and scarlet blankets, made at the Rochester Mills, New Hampshire; of No. 520, wool-dyed black sattinetts, of fine material and strong fabric, manufactured by Wm. De Forrest & Co., Naugatuck, Connecticut, and deposited by Robert Grant.

Several very creditable articles in this department of the exhibition, were deposited too late to come under the notice of the judges.

III.—*Carpets and Oil Cloths.*

The Committee awards to the Thomsonville Manufacturing Company, Connecticut, for No. 419, deposited by Messrs. Hamilton & Daily, a two ply ingrain carpet, which, in the opinion of the judges, will compare advantageously with any article of the same kind now made. A Silver Medal.

To Andrew Johnson, of Cincinnati, Ohio, for No. 809, deposited by him, the best table oil cloth ever exhibited here. A Silver Medal.

To Andrew Alcorn, for an ingrain carpet, No. 139.

A Certificate of Honorable Mention.

To Hugh Smith, of Philadelphia, for No. 138, a list carpet, considered to be the best article of the kind exhibited.

A Certificate of Honorable Mention.

The oil cloths manufactured by Potter & Carmichael, and those by J. Macauley, Jr., are very excellent specimens, and will support the credit of the establishments where they were made.

To Wm. Silcox, of Philadelphia, for No. 518, manilla grass rugs, with woollen yarn borders. A Certificate of Honorable Mention.

IV.—*Silk and Manufactures of Silk.*

The specimens in this branch were very creditable to the manufacturers. The following awards are made:

To Mrs. H. McLanahan, of Philadelphia, for No. 351, three cases of reeled silk and sewing silk, for fringes, taken from an assortment kept for sale and not manufactured expressly for exhibition.
A Silver Medal.

To Samuel Ross, of Philadelphia, for No. 454, silk and hair damask seating, believed to be the first specimen of the kind yet exhibited.
A Certificate of Honorable Mention.

Beautiful specimens of the same kind of article, No. 717, manufactured by John George, of Philadelphia, richly entitled to a premium, were too late for competition.

To Wm. Morris Davis, Montgomery county, Pennsylvania, for No. 34, deposited by maker, two lots of raw silk, carried through the several processes from the worm to the hand, by the grower.
A Certificate of Honorable Mention.

To Miss A. E. Storer, of Philadelphia, for No. 351, one case of *reeled silk*, considered by the judges to be the best exhibited.
A Certificate of Honorable Mention.

To C. A. Walborn, of Philadelphia, for No. 24, stocks, part of which are made of American satin.
A Certificate of Honorable Mention.

To Geo. W. Ward, of Philadelphia, for No. 371, one case of stocks.
A Certificate of Honorable Mention.

To Ann Holt, of Philadelphia, for No. 207, six cards of silk covered buttons. A Certificate of Honorable Mention.

The judges also refer with approbation to a specimen of American satin, made at Economy, Pennsylvania.

As at former exhibitions, several deposites were made too late to be noticed, in accordance with the rules of the exhibition; the Committee regret to find on this list names which were excluded from the same cause from competition at the last exhibition.

An interesting letter from Mrs. McLanahan, giving particulars, which should form part of the documentary history of the silk manufacture in our country, is appended to the report of the judges. The Committee of Premiums has referred it to the Committee on Publications, to make such extracts from it as they may deem proper for publication in the Journal of the Franklin Institute.

V.—*Iron and Steel.*

The importance of this manufacture is felt by every intelligent member of the community, and its progress must be a source of legitimate congratulation. The depressed condition of the industry of

our country has in no branch been more deeply felt than in this, and it cannot be a matter of surprise, though it is of regret, that the promise held out at the last exhibition of so decided advance, especially in the manufacture of iron with anthracite as a fuel, has not been realized. The report of the judges upon the specimens submitted, is referred for publication to the appropriate committee. The following awards are made:

To James Wood & Sons, of Philadelphia, for No. 492, two bundles of imitation Russia sheet iron, of surface equally smooth with the imported article and of uniform color, a new manufacture.

A Silver Medal.

Messrs. Yeardsley & Forsyth, of Chester county, Pennsylvania, for part of No. 143, deposited by Morris & Jones, viz: a boiler head of rolled iron, 48 inches in diameter and half an inch thick.

A Certificate of Honorable Mention.

The judges also refer with commendation to a bar of rolled iron from the Colemanville works, and to a round bar of axle iron by Valentine & Thomas, of the Bellefonte and Juniata Iron Works; also to No. 118, a bundle of nail rods, deposited by E. J. Etting & Brother.

VI.—*Umbrellas.*

This is a department of manufacture which is attracting increased attention, and the specimens in which have been very creditable to the depositors. The judges recommend, and the Committee makes the following awards:

To Wright & Brothers, of Philadelphia, for No. 453, consisting of hollow ribbed steel frame silk umbrellas, with patent springs; of silk umbrellas with whalebone frames, and of gingham umbrellas of American gingham, rendered water proof by a cheap composition.

A Silver Medal.

To J. Morris, Heston & Co., of Philadelphia, for No. 189, a light colored parasol with the handle inlaid with mother of pearl.

A Certificate of Honorable Mention.

To McGowen & Brothers, of Philadelphia, for No. 202, a light colored sun shade. A Certificate of Honorable Mention.

VII.—*Lamps and Gas Fixtures.*

These were few in number, and the judges recommend no special awards. The lamps for burning camphine and lard, were good specimens of the modes of applying these materials to the purpose of illumination, and the display of lamps and gas fixtures by Cornelius & Co., sustained the character of these gentlemen for taste and skill.

VIII.—*Hardware and Cutlery.*

This branch of domestic industry present considerable novelty from year to year, owing to its rapid progress. The specimens exhibited this year, though not so numerous as at the last exhibition, were of remarkable excellence. The display of guns and rifles is especially praised by the judges, to whose report the Committee refers for the particulars of the exhibition of hardware and cutlery. Great pains

have been taken in examining the various articles, and the report upon them by the judges is so full that the Committee has merely to follow it in making the awards. The following are accordingly made.

To George Machin, of Philadelphia, for No. 124, a card of files and rasps, comparing favorably with the best imported articles of the same kind. A Silver Medal.

A question having been raised in reference to the manufacture of these articles, the judges obtained evidence entirely satisfactory to them, that they are of domestic workmanship.

To Bradley & Beecher, of Naugatuck, Connecticut, for No. 295, two cases of pen and pocket knives, of excellent quality and various patterns. A Silver Medal.

To the New England Screw Co., Providence, Rhode Island, for No. 345, deposited by Curtis & Hand, for samples of screws of most admirable workmanship. A Silver Medal.

To R. Heinisch, for No. 243, a case of tailors' and bankers' sheers. A Silver Medal.

The judges recommended an award for No. 510, specimens of iron butt hinges, made by W. Hart Carr, combining strength and durability with cheapness, but as Mr. Carr is a member of the Board of Managers, the regulations of the Institute forbid the award.

To L. Goujon & Sons, of Philadelphia, for No. 51, wood screws and rivets. A Certificate of Honorable Mention.

To E. Hunt & Brothers, of East Douglass, Massachusetts, for No. 109, six scythes, "well made, and worthy the attention of the trade." A Certificate of Honorable Mention.

To William Robinson, of Philadelphia, for Nos. 135 and 563, two rifles, considered by the judges beautiful specimens of American work, and a beautifully finished double barrelled gun. A Certificate of Honorable Mention.

To John Krider, of Philadelphia, for No. 283, a case of admirably made guns. A Certificate of Honorable Mention.

To the Home Manufacturing Company, of Birmingham, Connecticut, for No. 414, deposited by Wightman & Wilcox, sample of machine made pins. A Certificate of Honorable Mention.

To Homer, Foote & Co., of Springfield, Massachusetts, for No. 345, deposited by Curtis & Hand, a case of Screw wrenches. A Certificate of Honorable Mention.

To T. Rowland & Brothers, of Philadelphia, for No. 538, an elliptic spring, superior to any thing of the kind before exhibited here. A Certificate of Honorable Mention.

To G. & W. N. Ropes, Maine, for No. 702, deposited by Thomas Zell & Co., a card of well made knives and forks. A Certificate of Honorable Mention.

To Samuel Jackson, of Baltimore, for No. 447, deposited by George P. Schively, three pocket knives and one case of razors, skilfully and tastefully made. A Certificate of Honorable Mention.

To Tryon & Sons, of Philadelphia, for No. 848, a rifle and pistols, remarkably well made in every respect. A Certificate of Honorable Mention.

To Haywood & Sturdevan, for No. ——, deposited by W. P. Cresson & Brothers, a box of machine-made horse nails.

A Certificate of Honorable Mention.

To James Barton, of Philadelphia, for No. 457, a lock for fire proofs.

A Certificate of Honorable Mention.

To Pierpont & Hotchkiss, New Haven, Connecticut, for No. ——, deposited by W. P. Cresson & Co., two stands of door locks and knobs of excellent workmanship.

A Certificate of Honorable Mention.

To Rodenbough, Stewart & Co., of South Easton, Pennsylvania, for No. 345, deposited by Curtis & Hand, and by Livingston & Lyman, two bundles of fine iron wire, well polished and of uniform thickness. A Certificate of Honorable Mention.

To Spang & Wallace, for No. 80, an elegantly finished rifle.

A Certificate of Honorable Mention.

To Joseph McCredy, of Philadelphia, for No. 43, a case of woven wire for paper makers, one piece of which is of extraordinary width of excellent manufacture. A Silver Medal.

IX.—*Saddlery, Harness and Trunks.*

The specimens of these articles were by no means so numerous as at former exhibitions, nor so well calculated to attract attention. The judges speak well of them generally, and in accordance with their remarks, the Committee makes the following awards:

To Thomas Moyer, of Philadelphia, for part of No. 158, the trunk and saddle without a pad, which are severally considered to be the best exhibited. A Certificate of Honorable Mention.

To W. N. Lacey, of Philadelphia, for No. 107, a set of single and of double harness, calculated to add to the credit of American workmanship in this department. A Certificate of Honorable Mention.

To R. Carey, of Philadelphia, for part of No. 326, a shaftoe saddle, with a spring bar, and without a pad.

A Certificate of Honorable Mention.

To Francis, Field & Francis, of Philadelphia, for No. 205, consisting of saddlery ware, the japanned work of which is especially referred to by the judges. A Certificate of Honorable Mention.

To Mahlon Warne, of Philadelphia, for No. 505, a sulkey bridle without winkers, which vies with the same part of the "Ashburton harness." A Certificate of Honorable Mention.

To William P. Taylor, of Philadelphia, for No. 180, deposited by B. F. Taylor, a valise trunk. A Certificate of Honorable Mention.

X.—*Models and Machinery.*

The specimens of this important department were by no means as interesting as those presented at previous exhibitions. The judges reflect with considerable severity upon the character of some of the workmanship. Nevertheless certain of the articles were of great value in reference to the ingenuity of invention, and many were also very creditable specimens of work. The Committee makes the following awards, founded upon the detailed report of the judges:

To Alexander Calderhead, of Philadelphia, for No. 516½, a carpet loom, remarkable for its simplicity and efficiency.

A Silver Medal.

To John O. Bradford & Co., for No. 660, a knitting machine deposited by them, and made by Eastwick & Harrison, of Philadelphia, of the ingenuity and usefulness of which the judges speak very highly.

A Silver Medal.

To Parson & Wilder, Hoosick Falls, New York, for No. 99, deposited by J. B. Hughes, an improved cloth shearing machine.

A Certificate of Honorable Mention.

To Oare & Pittman, Lowell, Massachusetts, for No. 175, an improved machine for carding wool.

A Certificate of Honorable Mention.

To C. H. Eisenbrandt, Baltimore, Maryland, for No. 822, deposited by maker, a writing machine for the use of the blind.

A Certificate of Honorable Mention.

To T. Mason, of Philadelphia, (a youth,) for No. 315, a complete working model of a fire engine, very beautifully executed.

A Certificate of Honorable Mention.

The Committee further awards to W. A. Armstrong, of New York, for No. 751, a knife cleaner, well adapted to use in large families.

A Certificate of Honorable Mention.

Also to Samuel Pennock, of Kennett Square, Pennsylvania, for No. 871, an ingenious drilling machine, for planting corn, wheat, &c.

A Certificate of Honorable Mention.

The judges recommend for examination by the committee on Science and the Arts, No. 338, a model of a three-ply carpet loom, by J. A. Scott, No. 352, a model of a compound capstan, by R. C. Taylor, and No. 278, a stone cutting machine, by Hines & Houpt.

The beautiful self-acting medal ruling machine, by Joseph Saxton, of the U. S. Mint, excited general admiration. As Mr. Saxton is a member of the Board of Managers, no further notice can be taken of it here.

To J. M. Clintock, of Philadelphia, for No. 380, a mortising machine.

A Certificate of Honorable Mention.

The Committee would have made an award to Wm. Smith, of Philadelphia, for No. 813, a bank note transferring press, had it been brought to the exhibition in time.

A lathe by Charles L. Oram, is worthy of notice.

A fire engine, deposited by John Agnew, is very creditable to him as a manufacturer of this article. Mr. Agnew being a member of the Board of Managers, no award can be given to it.

XI.—*Stoves and Grates.*

In no branch of the exhibition has there been a greater amount of competition than in this. The specimens of stoves for parlors and kitchen use, and the cooking ranges were numerous, and the locality of the exhibition afforded an excellent opportunity for showing practically the various merits of the different forms. In all of those made

of cast iron, the improvements in the art of iron founding were distinctly to be marked.

The judges were of opinion that no one of the cooking stoves was superior in usefulness and durability to some which have received the premiums on former occasions. The cooking ranges were in general those which have already met with commendation, one of them, however, presenting novel features, is recommended for the award of a medal.

As the opinion of the Committee of judges is fully given in their report, it has been referred for publication in the Journal of the Institute.

The Committee awards to Julius Fink, of Philadelphia, for the cooking range, No. 42, deposited by him. A Silver Medal.

To John Estlin, of Philadelphia, for No. 261, a cooking stove.
A Certificate of Honorable Mention.

To Pleis, Foering & Co., of Philadelphia, for No. 438, "a salamander stove with a very convenient appendage for heating sad irons."
A Certificate of Honorable Mention.

This stove is understood to be the invention of Mr. Frederick Foering.

To J. L. Mott, of New York, for No. 487, deposited by Dewitt C. Mott, consisting of several stoves, with new and ingenious contrivances. A Certificate of Honorable Mention.

To J. L. Mott, of New York, for No. 487, deposited by Dewitt C. Mott, a portable open boiler, or cauldron, and furnace.
A Certificate of Honorable Mention.

To Harned & Elliot, for No. 365, a parlor self-regulating stove, of remarkably neat form, for burning coal, combining great economy of fuel, with cleanliness.
A Certificate of Honorable Mention.

To Samuel R. Andrews, of Philadelphia, for No. 495, a cooking range. A Certificate of Honorable Mention.

To Samuel Lloyd, Philadelphia, for No. 667, a cooking range.
A Certificate of Honorable Mention.

XII.—*Cabinet Ware.*

No department of the decorative arts has shown more improvement than this, in the quality of the articles exhibited. The report of the judges is full and explicit, and containing hints which may be of service to this branch of art, is referred for publication.

To C. H. & J. F. White, for a sofa and chairs, "very superior specimens of design and workmanship." A Silver Medal.

To J. & A. Crout, of Philadelphia, for No. 121, a centre table of Lombardy Poplar, remarkable for "boldness and beauty of design, and elegance of workmanship." A Silver Medal.

To J. P. Sherborne, of Philadelphia, for No. 79, two dressing bureaus, "beautiful specimens of furniture, in the Tudor Gothic style."
A Certificate of Honorable Mention.

XIII.—*Musical Instruments.*

The judges have, as usual, given much attention to the examination of the instruments produced for exhibition. They speak highly of the pianos as presenting, on the average, an improvement upon those exhibited in former years, but do not consider the excellence of any one or more as sufficiently marked to require the award of the highest honors of the exhibition. Their report has been referred to the Committee on Publications. They notice especially No. 276, from the manufactory of Messrs. Reichenbach & Co., of Philadelphia; No. 521, from A. H. Gale, of New York, deposited by J. C. Smith; Nos. 282 and 246, from C. Meyer, of Philadelphia; and No. 123, from the Manufacturing Company of Philadelphia.

In accordance with their recommendation, awards were made,

To T. J. Weygandt, of Philadelphia, for No. 227, an eight keyed flute, remarkable for its strength of tone and fullness, and richness in the lower parts of the scale. A Certificate of Honorable Mention.

To J. Pfaff, of Philadelphia, for No. 396, an eight keyed flute, admired for the "sweetness and richness of its upper notes."
A Certificate of Honorable Mention.

XIV.—*Glass, China and Earthenware.*

One of the most interesting and generally noticed portions of the display at this exhibition consisted of the articles of earthenware.

The articles, No. 106, made by Abraham Miller, consisting of the finer kinds of earthenware, as plates, vases, and ornamental flower pots, were recommended for a premium, but in consequence of Mr. Miller being a member of the Board of Managers of the Institute, this cannot be awarded.

The Committee awards to the American Pottery Company, of Jersey city, for No. 31, deposited by Peter Wright & Sons, and consisting of embossed-ware jugs, tea ware, spittoons, &c., of spittoons with white raised figures, of druggists' jars, &c. A Silver Medal.

To the Boston and Sandwich Glass Company, for the best display of cut glass in the exhibition, deposited by W. M. Muzzey, S. Tyndale and James Kerr. A Silver Medal.

To the Union Glass Works of Philadelphia, for No. 147, deposited by Charles B. Austin, the best specimen of colored glass exhibited.
A Silver Medal.

To Coffin, Hay & Bowdle, of the Jersey Glass Works, for No. 159, deposited by them, window glass, showing improvements in this useful branch of manufacture. A Certificate of Honorable Mention.

To C. M. Greiner, of Philadelphia, for No. 9, specimens of painting upon porcelain. A Certificate of Honorable Mention.

It is to be regretted that the artist has expended so much labor and time in decorating an inferior porcelain article of foreign manufacture.

XV.—*Paper Hangings.*

Although the excellence of the specimens of paper hangings was as

great as at the last exhibition, the number and variety was very much reduced. The Committee, nevertheless, agrees with the judges in the opinion that the intrinsic excellence of the articles presented by Howell & Brothers, entitles them to high commendation. The Committee awards to Howell & Brothers, Philadelphia, for No. 36, deposited by them, specimens of paper hangings in various styles.

A Certificate of Honorable Mention.

XVI.—*Books and Stationary.*

The judges speak in terms of high commendation of the improvement manifested in all the parts of what may be called the manufacture of books, including the paper, the typography, and binding, beautiful specimens of which have this year been exhibited. There was no novelty in the exhibition of paper; the same varieties, and from nearly the same makers, having been presented as at the last exhibition. Many articles of stationary were for the first time produced, with a perfection which must establish their use in the stead of the corresponding imported ones.

The printing papers of Tileston & Hollingsworth, of Milton, Massachusetts, and of H. V. Butler, of Paterson, New Jersey, are favorably noticed by the Committee of judges. The copper plate printing paper of Tileston & Hollingsworth, received special notice at the last exhibition, as was also the case with the colored papers for lining books, make by R. & A. H. Hubbard, of Norwich, Connecticut.

In book-binding, the Committee awards to Benjamin Gaskill, of Philadelphia, for No. 381, excellent specimens of book-binding.

A Certificate of Honorable Mention.

To Lippincott & Co., of Philadelphia, for No. 435, containing beautiful specimens of binding. A Certificate of Honorable Mention.

The judges particularly refer to the execution of the edition of Byron, which is one of the books exhibited in No. 435, highly commending every part of it, and especially noticing the stereotyping by Mr. Fagan.

To C. Carle, of Philadelphia, for No. 157, specimens of book binding, designed with taste and executed with skill.

A Certificate of Honorable Mention.

To Johnson & Smith, Philadelphia, for No. 1, containing specimens of types made by them.

A Certificate of Honorable Mention.

To Carey & Hart, of Philadelphia, for No. 385, the Gift for 1843, entirely of American materials.

A Certificate of Honorable Mention.

In the articles of stationary, the judges refer with the highest praise to the superior work of the Blank Books, manufactured by Hogan & Thompson, of Philadelphia; also to the steel pens, the wafers, sealing wax and ink, exhibited by them, for which, however, no award can be made on account of Mr. Thompson's position as a manager of the Institute. The blank books bound by Thomas Leitch, and by Messrs. Lippincott & Co., are also noticed.

The writing papers of Jessup & Brothers, of Westfield, Massachu-

setts, and of R. & A. H. Hubbard, of Norwich, Connecticut, were noticed at the last exhibition.

The Committee now awards—

To Joseph C. Robinson, for No. 391, deposited by Mr. Conrad, a beautiful specimen of large writing paper.

A Certificate of Honorable Mention.

To the Wading River Co., of McCartyville, New Jersey, for a specimen of cloth paper, contained in No. 455, deposited by Wm. McCarty. A Certificate of Honorable Mention.

The different black inks exhibited were found to be of good quality.

The admirable wall paper of C. &. W. H. Magarge was noticed at the last exhibition.

The articles deposited by R. Lindsey & Co., fully sustained the reputation of that house, but were too late for competition.

XVII.—*Fine Arts.*

The following awards are made, with reference to the opinions expressed by the Committee of judges:

To A. Cornu, of Philadelphia, for No. 233; drawings of machinery, &c., executed with the pen, and remarkable for exactness and beauty.

A Certificate of Honorable Mention.

To J. Gibson, of Philadelphia, for No. 497; painted imitations of various woods. A Certificate of Honorable Mention.

To John T. Bowen, of Philadelphia, for No. 361½, specimens of colored lithographic prints, from drawings by Audubon.

A Certificate of Honorable Mention.

The judges also speak with commendation of No. 96, paintings of fruit, &c., by G. B. Ord; of No. 82, drawing of the excavator, for railroads, by S. R. Mason; of No. 462, imitation of crayon drawings, by Victor Ernette; of No. 850, machine drawings, by H. R. Campbell, and of No. 772, two views of the volcano of Katuca, in the island of Hawaii.

The Committee awards:

To C. K. Frost, of Philadelphia, for No. 70, beautiful specimens of engraving on wood, in different departments of the art.

A Certificate of Honorable Mention.

To T. Mumford, of Philadelphia, for No. 102, fine engravings on wood. A Certificate of Honorable Mention.

XVIII.—*Silver and Plated Goods.*

The report of the Committee of judges who examined the articles of this class, is clear and explicit; following its indications, the Committee of Premiums awards:

To Bailey & Kitchen, of Philadelphia, for No. 321, a silver tea service, with spoons, forks, &c., of beautiful design and workmanship.

A Certificate of Honorable Mention.

To Bard & Lamont, of Philadelphia, for No. 376, a fireman's horn, of silver, of fine proportions and finish.

A Certificate of Honorable Mention.

To Samuel Bland, of Philadelphia, for No. 209, a patent lever watch. A Certificate of Honorable Mention.

XIX.—*Book Binders' Tools.*

There can hardly be said to have been competition in this department of the exhibition, the specimens being in different branches of the art.

The following awards are made as most justly due by the intrinsic excellence of the work:

To Gaskill & Copper, of Philadelphia, for No. 23, containing various specimens of book binder's stamps, of beautiful workmanship, presenting improvement upon those heretofore exhibited by them.
A Certificate of Honorable Mention.

To Allen Leonard, of Philadelphia, for No. 166, a brass die for embossing, exhibiting, according to the report of the judges, skill, taste, and judgment. A Certificate of Honorable Mention.

The steel dies for embossing, No. 398, by A. C. Morin, fully sustain the character of the work of that artisan.

XX.—*Marble and Statuary.*

The committee makes the following awards:

To Joseph Maples, of Philadelphia, for No. 254, a small sarcophagus, of Italian marble, of creditable design and workmanship, and a slab, with a shield encircled by a laurel wreath beautifully wrought.
A Certificate of Honorable Mention.

To John McFadden, of Philadelphia, for No. 88, an Italian marble bath with figures inlaid, in imitation of Mosaic.
A Certificate of Honorable Mention.

XXI.—*Hats and Caps.*

Few of these articles were exhibited. The judges mention the hats deposited by Charles Oakford, as remarkable for the fineness of the materials of which they are made, and speak favorably of the hats and caps deposited by Charles F. Raymond, of the hats and military caps deposited by John Simpson, and of the beaver bonnet deposited by Emmor Kimber, Jr.

An award is made to H. S. Miller, Philadelphia, for No. 355, deposited by maker, six hat bodies, which are in the opinion of the judges the best exhibited. A Certificate of Honorable Mention.

XXII.—*Combs and Brushes.*

The following awards are made to the makers of these articles:

To S. Winner, of Philadelphia, deposited by maker, for No. 226, a case of combs, good in style and workmanship.
A Certificate of Honorable Mention.

To Meyers Busch, of Philadelphia, for No. 604, a case of fancy brushes. A Certificate of Honorable Mention.

The brushes made by the pupils of the Pennsylvania Institution for

the instruction of the blind, No. 313, are considered decidedly better aticles than those submitted at the last exhibition.

XXIII.—*Coach Work.*

Some of the specimens under this head, were much admired.—Awards were made:

To Ogle & Watson, Philadelphia, for No. 504, deposited by maker, the Ashburton carriage, pronounced by the committee of judges to be of superior workmanship. A Silver Medal.

To A. Knowles & Co., Philadelphia, for No. 73, deposited by maker, two neat and well finished sleighs.

A Certificate of Honorable Mention.

XXIV.—*Leather and Morocco.*

This branch of the exhibition was meagre indeed, in the number of specimens presented. Without entering into the reasons which might be assigned for this, the committee would observe that the manufacturers of our city alone, have not been fully represented in this article, and would recommend to the enterprising members of this trade to let the public have a fairer sample as to the extent of their work at the next exhibition.

The articles deposited by Scattergood & Boustead, by Lippincott, and by A. & J. Peterson, fully sustained their high reputation for skill in their art.

The Bag Hide, by Scattergood & Boustead, is a fine article, and would do credit to any shop or market.

A Certificate of Honorable Mention.

XXV.—*Boots and Shoes.*

In accordance with the spirit of the report of the Committee of judges, the following awards are made:

To J. A. Sengenberger, of Philadelphia, for No. 177, the best specimens of boots and shoes exhibited.

A Certificate of Honorable Mention.

To J. Thornley, of Philadelphia, for No. 363, India rubber shoes, which show considerable improvement in these articles.

A Certificate of Honorable Mention.

The judges speak favorably also of the India rubber boots and shoes exhibited by John L. Ripley, and express a regret that some of the best specimens of boots and shoes were brought to the exhibition too late to come under their notice.

XXVI.—*Chemicals.*

The specimens of chemical preparations were very beautiful.—Those of Wetherill & Brothers, Harrison & Brothers, Carter & Scattergood, and Farr, Powers & Weightman, are all spoken of in high terms by the judges. The glass, for chemical purposes, manufactured by the New England Glass Co., and deposited by W. M. Muzzey, is strongly recommended to chemists.

The judges recommend the following awards which are hereby made.

To Carter & Scattergood, of Philadelphia, for No. 297, a very beautiful specimen of Prussian blue

A Certificate of Honorable Mention.

To Farr, Powers & Weightman, of Philadelphia, for the general excellence of the preparations exhibited by them, Nos. 406 and 407.

A Certificate of Honorable Mention.

The Committee awards:

To Eugene Roussel, of Philadelphia, for No. 224, the best display of soaps, perfumery, &c., yet exhibited. A Silver Medal.

XXVII.—*Philosophical Apparatus.*

This is a growing and useful branch of the mechanic arts. The Committee regards the execution of the meridian circle, by William J. Young, as marking a new era in the application of the arts. The report of the judges, which is very full upon all the articles, is referred for publication. The Committee in accordance with the recommendations of the judges, awards:

To William J. Young, of Philadelphia, for No. 872, a five feet meridian circle, or transit instrument, copied from the High School Transit of Ertel & Sons, of Munich. A Silver Medal.

To A. D. Crane, for No. 356, deposited by Smith & Brothers, of Philadelphia, a clock with a torsion pendulum, a curious and compact form of mantle clock. A Silver Medal.

To James F. Duffey, of Philadelphia, for No. 256, various electro-magnetic instruments of neat execution.

A Certificate of Honorable Mention.

To Thomas Hill, of Cambridge, Massachusetts, for No. 517, a machine for assisting in determining the occurrence of time of occultations and called an "occultator." A Certificate of Honorable Mention.

To James Bingham, for No. 519, various articles of electro-magnetic apparatus, neatly executed.

A Certificate of Honorable Mention.

To H. M. Paine & Co., of Liecester, Massachusetts, for No. 857, periscopic and cylindrical spectacles.

A Certificate of Honorable Mention.

The judges also speak in terms of warm commendation of a gold lever watch, No. 209, the movement of which, except the chain and main spring, was executed by Samuel Bland; of a case of watch dials, No. 210, by Wm. J. Mullen; and of an admirably finished theodolite, No. 244, by Edmund Draper.

In the spirit of encouragement to youthful efforts, which the Franklin Institute has always manifested, the following award is made:

To James Duffey, Jr., of Philadelphia, for No. 275, containing, among other articles of philosophical apparatus, a model of a combination of machinery. A Certificate of Honorable Mention.

XXVIII.—*Straw Goods.*

In accordance with the recommendations of the judges, the award is made:

To Miss Blake, of Wrentham, Massachusetts, part of a case, No. 443, deposited by Thomas White, a straw bonnet, the beautiful plaiting of the material of which was executed by her.

A Silver Medal.

XXIX.—*Surgical Instruments, &c.*

There was not much variety in these articles. In accordance with the report of the acting judges, the Committee awards:

To E. Flohr, of Philadelphia, for No. 430, a mounted cranium.

A Certificate of Honorable Mention.

To B. C. Everett, of Philadelphia, for No. 334, a case of surgical bandages. A Certificate of Honorable Mention.

The abdominal supporter by Dr. Banning, although coming too late to enter into the competition, is thought so highly of by the judges on surgical instruments, that the Committee awards it,

A Certificate of Honorable Mention.

XXX.—*Copper, Brass, and Plumbers' Work.*

There was very little variety in the articles classed under this head. The judges speak favourably of the copper tubes for locomotive boilers, No. 49, by Wayne & Roberts, of Philadelphia; of the large bell, No. 357, by L. Debozear, of Philadelphia; and of brass castings, by Isaac Babbit, of Boston.

XXXI.—*Tin Ware.*

The display of tin ware was not more various than on former occasions, the judges recommend, and the Committee awards:

To Harned & Elliott, of Philadelphia, for No. 274, a tin ball, or sphere, twenty-eight inches in diameter, for a steeple ball.

A Certificate of Honorable Mention.

XXXII.—*Paints and Colors.*

The specimens of paints and colors exhibited were highly creditable to the manufacturers. The judges recommend the following award which is hereby made.

To R. A. Tilghman, of Philadelphia, for No. 548, specimens of superior chromate of lead. A Certificate of Honorable Mention.

The judgment of the Committee on chemicals, in reference to the excellence of the Prussian blue, No. 297, of Carter & Scattergood, is confirmed by the judges on paints and colors, who also recommend it to Honorable Mention.

XXXIII.—*Fancy Articles.*

It is believed that the quality of the specimens of fancy articles was better than at preceding exhibitions. The following awards are made in compliance with the recommendations of the Committee of judges.

To Thomas Bogue, of Philadelphia, for No. 309, "a case of gentlemen's wigs and scalps." A Certificate of Honorable Mention.

To F. J. Dressler, of Philadelphia, for No. 422, a case of fancy hair work—the best exhibited. A Certificate of Honorable Mention.

To T. B. Smith, of Philadelphia, for No. 516, an assortment of pickles of excellent flavor. A Certificate of Honorable Mention.

To Joseph S. Dunlap, of Philadelphia, for No. 394, a jar of candy, the best exhibited. A Certificate of Honorable Mention.

The display of confectionary, by Mr. Parkinson, is very creditable, and evinces a high degree of excellence in this branch of manufacture. The beautiful pagoda, seven and a half feet high, of transparent candy, which ornamented the summit of the centre circular table, in the exhibition room, was made by him, and added much to the effect of the general view. A Certificate of Honorable Mention.

The Committee proposes to submit those of the reports of the judges which are most interesting, to the Committee on Publication of the Institute.

Practical & Theoretical Mechanics & Chemistry.

New Act of Congress providing for the Registering of Designs, and for Amending the Patent Law in certain particulars.

It has long been a subject of serious and just complaint that the laws of the United States did not afford any protection to the art of designing, as applied to a number of manufactures; the subjoined act of Congress removes this difficulty, giving an exclusive right to the author, or inventor, of any new design, for seven years. This protection will be very extensive in its application, and in a number of instances where patents have been refused under the laws previously existing, they may be obtained under that now presented. Many very ornamental patterns, for example, have been made for stoves, which have been got up in good taste, and at great expense; but as the article did not present any thing new in the principle of its construction and operation, a patent could not be granted for it.

There are a great number of cases in which it will not be possible to comply with the requirement of the last section of this act. If a person obtains a patent for improved pins, needles, nails, or screws, or for an improved liquid for burning in lamps, he will be at some loss in attempting to "stamp on each article vended, or offered for sale, the date of the patent." This appears to be a strange oversight in the wording of the law. If it had provided that whenever the word patent was stamped upon an article, it should be accompanied with the date of the patent, the thing would have been practicable. The phraseology of this section is obscure in other respects.

An Act in addition to an Act to Promote the Progress of the Useful Arts, and to Repeal all Acts, and parts of Acts, heretofore made for that purpose.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Treasurer of the United States be, and he hereby is, authorized to pay back, out of the patent fund, any sum or sums of money, to any person who shall have paid the same into the Treasury, or to any receiver or depository, to the credit of the Treasurer, as for fees accruing at the Patent Office through mistake, and which are not provided to be paid by existing laws, certificate thereof being made to said Treasurer by the Commissioner of Patents.

Sec. 2. *And be it further enacted,* That the third section of the act of March, eighteen hundred and thirty-seven, which authorizes the renewing of patents lost prior to the fifteenth of December, eighteen hundred and thirty-six, is extended to patents granted prior to said fifteenth day of December, though they may have been lost subsequently: *Provided, however,* The same shall not have been recorded anew under the provisions of said act.

Sec. 3. *And be it further enacted,* That any citizen or citizens, or alien or aliens, having resided one year in the United States, and taken the oath of his or their intention to become a citizen or citizens, who by his, her, or their, own industry, genius, efforts, and expense, may have invented and produced any new and original design for a manufacture, whether of metal or any other material or materials, or any new and original design for the printing of woollen, silk, cotton, or other fabrics, or any new and original design for a bust, statue, or bas relief, or composition in alto or basso relievo, or any new and original impression or ornament, or to be placed on any article of manufacture, the same being formed in marble or other material, or any new and useful pattern, or print, or picture, to be either worked into or worked on, or printed, or painted, or cast, or otherwise fixed on, any article of manufacture, or any new and original shape or configuration of any article of manufacture not known or used by others before his, her, or their invention or production thereof, and prior to the time of his, her, or their application for a patent therefor, and who shall desire to obtain an exclusive property or right therein to make, use, and sell and vend the same, or copies of the same, to others, by them to be made, used, and sold, may make application in writing to the Commissioner of Patents, expressing such desire, and the Commissioner, on due proceedings had, may grant a patent therefor, as in the case now of application for a patent: *Provided,* That the fee in such cases, which by the now existing laws would be required of the particular applicant, shall be one-half the sum, and that the duration of said patent shall be seven years, and that all the regulations and provisions which now apply to the obtaining or protection of patents, not inconsistent with the provisions of this act, shall apply to applications under this section.

Sec. 4. *And be it further enacted,* That the oath required for ap-

plicants for patents may be taken, when the applicant is not for the time being residing in the United States, before any minister, plenipotentiary, charge d' affairs, consul, or commercial agent, holding commission under the Government of the United States, or before any notary public of the foreign country to which such applicant may be.

Sec. 5. *And be it further enacted,* That if any person or persons shall paint or print, or mould, cast, carve, or engrave, or stamp, upon anything made, used, or sold by him, for the sole making or selling of which he hath not or shall not have obtained letters patent, the name or any imitation of the name of any other person who hath or shall have obtained letters patent for the sole making and vending of such thing, without consent of such patentee, or his assigns or legal representatives; or if any person, upon any such thing not having been purchased from the patentee, or some person who purchased it from or under such patentee, or not having the license or consent of such patentee, or his assigns or legal representatives, shall write, paint, print, mould, cast, carve, engrave, stamp, or otherwise make or affix the word "patent," or the words "letters patent," or the word "patentee," or any word or words of like kind, meaning, or import, with the view or intent of imitating or counterfeiting the stamp, mark, or other device of the patentee, or shall affix the same, or any word, stamp, or device, of like import, on any unpatented article, for the purpose of deceiving the public, he, she, or they, so offending, shall be liable for such offence to a penalty of not less than one hundred dollars, with costs, to be recovered by action, in any of the circuit courts of the United States, or in any of the district courts of the United States having the powers and jurisdiction of a circuit court; one-half of which penalty, as recovered, shall be paid to the patent fund, and the other half to any person or persons who shall sue for the same.

Sec. 6. *And be it further enacted,* That all patentees and assignees of patents hereafter granted, are hereby required to stamp, engrave, or cause to be stamped or engraved, on each article vended, or offered for sale, the date of the patent; and if any person or persons, patentees or assignees, shall neglect to do so, he, she, or they, shall be liable to the same penalty, to be recovered and disposed of in the manner specified in the foregoing fifth section of this act.

JOHN WHITE,
Speaker of the House of Representatives.
WILLIE P. MANGUM,
President of the Senate pro tempore.

Approved August 29, 1842.

JOHN TYLER.

On the Manufacture of Sulphuric Acid. Read before the British Association for the Advancement of Science, by Mr. William Blyth.

The ordinary process of manufacturing sulphuric acid, by introducing into a leaden chamber a mixture of sulphurous acid, red nitrous fumes, and common air, has been long practiced. Like many other

improvements in the arts, it seems to have been more the result of chance than the application of scientific skill; and chemists remained long in the dark as to the true nature of the changes which took place in the vitriol chamber. The first satisfactory explanation was given to the world by Clement and Desormes, in 1806. These chemists discovered the white chrystalline compound which is now known to be formed when sulphurous acid, red nitrous fumes, common air, and the vapour of water, are mixed together, and exposed to a sufficiently low temperature. They also observed the remarkable property which it possesses of being decomposed when put into water, and of being resolved into nitric oxide and sulphuric acid. This fact they applied to explain the important part performed by the nitric oxide, in enabling the sulphurous acid to be still farther oxydized at the expense of the oxygen in the common air. The formation of the crystalline compound in the leaden chamber, its decomposition by the weak acid at the bottom of the chamber, and the evolution of nitric oxide to be again changed into red nitrous fumes by the oxygen of the common air—is the favorite theory of chemists at the present time, and seems to be now generally admitted. M. Adolph Rose, of Berlin, has recently published a paper on the "combination of hydrated sulphuric acid with nitric oxide. The object of the paper is to show that the impurity in the sulphuric acid of this country, which has hitherto been considered to be nitric acid, is not nitric acid, but a combination of sulphuric acid and nitric oxide. He also shows that this compound of sulphuric acid and nitric oxide, is identical with the white crystalline formed in the vitriol chamber. There are some facts mentioned in this important paper which deserve attention; and it is more particularly the object of these remarks to bring them under the notice of those members of the Association who may be interested in the manufacture of this important acid. It is well known that, in the making of sulphuric acid, when the acid in the chamber reaches the specific gravity of 1.450, it is impossible to go beyond this point without increasing the proportion of nitre; and even with an increased proportion of nitre, the product of acid is less than it ought to be. The reason is, that sulphuric acid, of the specific gravity of 1.450, acts very slowly in decomposing the white compound; and acid of the specific gravity of 1.500, will not act upon it at all, but, on the contrary, it has a tendency to dissolve and retain it.

Mr. Blyth demonstrated these facts by experiments.

M. Adolph Rose states that when sulphuric acid, containing the compound, is concentrated by distillation, at one part of the process pure acid comes over; and when the acid in the retort has reached the specific gravity of 1.84, it will be found, if examined, to contain nitric oxide. It follows from this, that when sulphuric acid is raised in the chamber above the specific gravity of 1.500, it will be found, after being rectified, more or less contaminated with the nitrous compound. He made a number of trials, to ascertain the effect of the nitrous compound upon indigo. Some of the compound was dissolved, by the aid of heat, in sulphuric acid of specific gravity of 1.600. To this solution he added some drops of a strong solution of indigo in pure rec-

tified sulphuric acid. The blue color of the indigo was immediately destroyed. M. Adolph Rose also states, that, if rectified sulphuric acid, which is contaminated either with nitric acid or nitric oxide, be diluted with twice its bulk of water, and concentrated by distillation till it reaches the specific gravity of 1.84, the concentrated acid will be found to have been freed from both of these compounds. It follows, from this experiment, that in order to obtain sulphuric acid sufficiently pure to be used in the preparation of sulphate of indigo, it would only be necessary to draw the acid from the chamber at a low specific gravity, not higher, perhaps, than 1.300 or 1.350. Rectified sulphuric acid, prepared from acid drawn from the chambers at the above strength, if found to be perfectly free from all nitrogeneous compounds, will be a great acquisition to the woollen dyer in the preparation of his sulphate of indigo; and when we consider the large quantities of acid used for this purpose, it will be admitted to be a subject of great importance. Lond. Athenæum.

Carpet Tapestry.

Professor Vignoles exhibited specimens of newly invented carpet tapestry, at a meeting of the British Association for the Advancement of Science, and he explained that these works were made on the principle of the ancient mosaics, being composed of innumerable transverse sections of woollen threads. No painting, no coloring, was used; all the effect was produced by ends of worsted about one-eighth of an inch long, standing vertically, one end being seen, and the other cemented by India rubber to a cloth. The exact operation was yet a secret, but he believed that two frames of fine wire, or perforated zinc, (some with even 4,000 perforations in an inch,) were placed over each other, exactly vertically, the distance being only regulated by the height of the room, in the present instance he believed about five feet. The picture to be copied being then traced on the top side of the upper frame, a workman passed threads of dyed wool through the corresponding holes in the top and bottom frames, of course, as in tapestry, varying his shades and colors until he is satisfied with the effect; this he can judge of by looking down on the upper ends of the threads, although to a person looking at the space between the frames, there seems only a confused and compact mass of worsted. When the workman is satisfied, the upper ends of the threads are covered with India rubber cement, and a cloth is laid upon them also covered with cement; the ends of the threads firmly adhere to this cloth. By means of a sharp cutting instrument, the entire mass of threads is now cut through transversely, at about one-eighth of an inch from the cloth, and this process being repeated, a fresh copy is obtained from every one-eighth of an inch. In the present frames, being five feet apart, 480 copies can be cut, and as there is no limit to the distance, except in the height of the apartment, thousands of copies may be taken of each. Were this not the case, the invention, however ingenious, would be too expensive to be purchased, except in solitary instances as specimens of curious art; but, from the facility of reproduc-

tion, this fabric was likely to come into general use for carpets, rugs, curtains, table and chair covers, &c.; for carpets and rugs it could be made with a longer nap, so as to give any degree of substance.

Ibid.

On the Improvement of the Telescope.

At the twelfth meeting of the British Association for the Advancement of Science, Mr. Fox Talbot said, that this subject occurred to him about two years ago, when the Earl of Ross (then Lord Oxmantoun) was making much larger specula for reflecting telescopes than had ever been obtained before; and he thought, if once we had a very large and perfect speculum, it might be possible to multiply copies of it by galvanic means. He had observed, that if an electrotype cast were taken from a perfectly polished surface, the cast was also perfectly polished; so that no defect of form from this cause could have an injurious effect on the speculum. The great and obvious defect was, that electrotypes were in copper, which reflected but little light. He mentioned these ideas to Professor Wheatstone, who said the same had occurred to him, and he showed him a paper which he had drawn up some months before, and in which he suggested the taking of the galvano-plastic casts of specula in platina, palladium, silver, or nickel, and for especial purposes gilding the copper; taking care that the two precipitations adhered well to each other. So that (said Mr. Talbot) the idea had suggested itself independently to both of them; but, on comparing notes, they found differences. Though it had occurred to him (Mr. Talbot) to precipitate white metals, yet he did not think that platina would have a sufficiently beautiful white metallic polish. Professor Wheatstone had, however, made choice of platina, and, varying the quantity till he found the required proportion, he obtained a mirror in platina, which appeared to him (Mr. Talbot) to have quite brilliant polish enough, and to be white enough to answer the purpose; and he considered, therefore, that Professor Wheatstone had proved, that, at least in one form, the specula of telescopes might be made by voltaic precipitation. His own idea was, that it might be possible to whiten the surface of the copper without injuring the form; and, therefore, having obtained a speculum in very bright polished copper, he (Mr. Talbot) whitened it, and transformed it into sulphuret of copper, and after having retained it about a year, he did not perceive the smallest alteration in any respect. This, therefore, appeared to him a mode by which important results for astronomers could be obtained. For the last year, perhaps, nothing further had been done, either by Professor Wheatstone or himself; but, the other day, being at Munich, he (Mr. Talbot) visited Professor Steinheil, who showed him his inventions, and told him he had discovered a method of making specula by the electrotype. It so happened, that both Professor Steinheil and himself had published their respective methods about a month or six weeks before, the Professor having read a communication on the subject before the Academy of Science at Munich, and printed it, and he (Mr. Talbot) having

published his in England. Their modes were, however, different, as Professor Steinheil precipitated gold on the speculum of copper; and having precipitated a certain thickness of gold, he then precipitated copper on the back of the gold, to give it sufficient thickness. He (Mr. Talbot) should have thought beforehand that gold would not reflect light enough to be available; but Professor Steinheil informed him he had found, by careful experiment, that it reflected more light than polished steel. He allowed Mr. Talbot to look through a Gregorian reflecting telescope, of which the speculum was a common one, but gilded, and he found the image perfectly clear and well defined. A slight tinge of yellow was thrown over all the objects, but the image was perfectly clear and defined.

Professor Steinheil said, that in the course of a year he should have a very large telescope, furnished not only with a speculum, but also with other apparatus, voltaically formed, so that telescopes might be made all from a good model, so as to insure greater accuracy of proportions; and in this way even very large telescopes might be constructed, at a comparatively trifling expense. With reference to precipitating copper on the back of the gold, the Professor had a simple expedient for securing adhesion. He first precipitated gold from the cyanide of gold, and he mixed with it cyanide of copper, and kept gradually increasing the quantity of the latter sort, so that an alloy was precipitated, which was continually increasing the copper with respect to the gold, till he had a speculum whose surface was gold, and which then became an alloy, the quality decreasing, till, at the bottom, it became pure copper. This was important, because without such experiments, one would not have known that such results would have followed, for some philosophers supposed that if we attempt to precipitate the salts of two metals, only one was precipitated; but Professor Steinheil informed him that they precipitated in union. He thus obtained a speculum with a face of gold and a back of copper.

Ibid.

On the Nature of Iron.

Mr. Nasmyth brought forward, at a meeting of the British Association for the Advancement of Science, several specimens to illustrate the remarks which he intended to make, in further illustration of former observations. From late accidents, arising from the breaking of axles, the public were alive to the subject, and it was desirable that the question should be examined. In locomotive engines, the axle was the chief point of danger, and it was, therefore, important, both as a scientific and practical question, to determine the nature and habitude of iron when placed under the circumstances of a locomotive axle. Experiment was the only way to discover this, and he would have wished to place iron under exactly similar circumstances, but the short time intervening since his last observations, had rendered it impossible to do so. One opinion at that time was, that the alternate strains in opposite directions, which the axles were exposed to, rendered the iron brittle, from the sliding of the particles over each other.

To illustrate this, Mr. Nasmyth took a piece of iron wire, and bent it back and forward; it broke in six bends. He had suggested annealing as a remedy for this defect—in proof whereof, he took a piece of annealed wire, which bore eighteen bends, showing an improvement of three to one in favor of annealing. He should, therefore, advise railway companies to include in their specification that axles should be annealed; he did not like the custom of oppressing engineers with useless minutiæ in specifications, but this was so useful and so cheap, that he considered it ought to be insisted on. To exhibit on a larger scale the effect produced on iron in our workshops, he showed a specimen of iron as it came from the merchant; being nicked with a chisel, it broke in four blows with a sledge, at the temperature of 60 degrees, with a crystalline fracture; by raising the temperature 40 degrees higher it bore twenty blows, and broke with the fibrous or ligneous fracture; so that the quality of iron was not the only circumstance to be considered as influencing the fracture. I noticed, also, (said Mr. Nasmyth) the injurious effect of cold swaging, as causing a change in the nature and fracture of the iron; and here let us take the practical workshop view of the case, and not run after the *ignis fatuus* of electricity or galvanism, but consider the practical effects. Swaging was necessary in many cases, for instance, when an axle had collars welded on, these could not be finished with the hammer, and certain tools called swages were used, from the action of which, great condensation of the iron took place, and a beautiful polish was given to the surface, with what injurious effect he would show by the next specimen, which had been heated red hot, and then swaged till cold; it broke at one blow, without nicking, and the fracture was very close and beautiful, like steel. This showed the fallacy of considering close fine grain a good test of excellence in wrought iron, but moderate swaging was often necessary, and not injurious, unless where an over regard to finish carried it to excess. To prove that annealing restored the toughness and fibrous texture, a portion of the last bar was heated, and cold-swaged till cold as before; then heated dull red, and left to cool gradually. It bore 105 blows without breaking, and at last was rather torn asunder than broken, as was shown by the specimen. This proved that the fibrous structure was restored by annealing, and he, therefore, thought it should be insisted on in specifications. The effect of heating to welding-heat was very injurious, unless the iron was subsequently hammered to close the texture. A piece of the same iron, heated to welding, and left to cool, broke without nicking, in one blow, showing very large crystals, especially in the centre. The effect of nicking was also very singular. The strength of iron was generally stated to be equal to its sectional area; but a nick not removing $\frac{1}{100}$ of the area, took away $\frac{1}{10}$ of the strength. Mr. Nasmyth broke a piece of nicked, or rather scratched, wire, to illustrate this point. These, and similar things, did not prove that science and practice were at issue; but, as Halley reached the great accuracy of his prediction of the return of his comet by taking into account the disturbing forces of Jupiter and Saturn, and the other planets amongst which the body had to pass, so scientific men should

seek in the workshops correctional formulæ, by learning there the practical occurrences which would elucidate their theories, and he hoped that these specimens might be of some use. Ibid.

Living under Water without communication with the Atmosphere. Dr. Payerne's Experiments.

One of the most remarkable experiments of modern times, was performed last week by a Dr. Payerne, at that excellent experimental school, the Polytechnic Institute, Regent street. Dr. P. descended in the great diving bell of that establishment, in his ordinary dress, and remained there for the space of three hours without any communication whatever with the upper air, and apparently without having been in the slightest degree affected or inconvenienced by his long submersion. He states that he could just as easily have remained down twelve or twenty-four hours; indeed he assigns no limit to his powers of subaqueous vitality. General Pasley, and several other eminent scientific individuals kept watch at the bell during the whole of the three hours, and were perfectly satisfied that no supply of vital air was conveyed to Dr. Payerne from above.

Now that this surprising feat, so long regarded as of the class of physical impossibilities has been at last accomplished, every one (as usual) is discovering how easy it is. It is only to take down with you something that will absorb the carbonic acid gas as fast as you generate it, and something else (with a lucifer match or two to heat it) from which you may get free oxygen enough to keep you alive. Doubtless these are the main conditions of the experiment—and there are several well known substances which do possess these two requisites. Pure potassa, for example, will absorb nearly half its weight of carbonic acid gas; and chlorate of potass gives out, when heated, 3915 parts per 100 of oxygen.

Dr. Payerne is said to be now engaged in constructing a subaqueous boat in which he will undertake to enter any enemy's harbour unseen, and in a single day apply the means of destruction to every ship it contains. Mech. Mag., May, 1842.

India Rubber Stoppers for Bottles.

At a meeting of the British Association for the Advancement of Science, Mr. Brockedon exhibited specimens of his patent India rubber stoppers for bottles, explaining the late improvements in the construction of the cores on which the India rubber is spread. The present cores, he said, were made of cotton twisted into strands, &c., by means of a machine which he explained by a diagram. The cylindrical rope now consisted of several strands of tightly twisted cotton, lapped with flax thread, and laid together longitudinally, loose fine cotton rovings being placed between them; the entire was then lapped in a cylindrical form with flax thread, attaining by this method the advantages of perfect roundness and firmness. They also gave sufficient hold to the corkscrew, and bore the heating process well. These

stoppers would slide on glass when wet, but not when dry (although there was no cohesion in this latter state,) so that the bottler, by slightly wetting these stoppers with the liquor which he was bottling, could easily insert them; and when this slight film of moisture was dried up, the stopper required considerable force to withdraw it.

Lond. Athenæum.

On Painting Timber.

We extract the following observations on painting timber when exposed to damp, by Mr. Lander, from the Professional Papers of the Royal Engineers.

I beg to lay before you a few observations which I have made on the construction and causes of decay in bridges, on the works at Devenport, having been employed on the erection of the bridge at the north-west barrier, in the years 1812 and 1813, and also on a large repair in 1837; and I am now employed on a similar repair at the north-east barrier bridge, which, I think, was built in 1816, which has induced me to make the following remarks:

1st. These bridges were paved with Guernsey pebbles, which, I think, was one cause of decay, as the wet constantly dripped through the joints, an evil which may be avoided by Macadamizing, by which such a compact body is formed that the wet cannot get through, and the joists and girders, &c., are thereby kept perfectly dry, besides the advantage of the vibration being very much reduced, as is the case now at the north-west barrier.

2nd. The wood work below, as well as the under side of the flooring, was frequently payed over with coal tar, which, forming a thick body on the surface, was another, if not the greater, cause of decay, as it completely prevented the air from acting on the wood, thereby keeping all moisture within, which of itself is sufficient to decay it. It must be observed that the plank, or flooring, was so rotten, that in many places it would not bear the weight of the workmen, and many of the joists and girders broke into pieces in removing them; some of them were found to be quite dry, and in a similar state to snuff.

3rd. As a further proof of the bad effects of the paying and painting bridges, I may state that the bridge at the south-east barrier across the old works leading to Stonehouse, the girders, joists, &c., of which have never been payed or painted, and the road above always Macadamized, remains sound and good at this time; and I know this to be a much older bridge than either of the former.

4th. I should state that the timber alluded to above is oak, but I think the same observations will apply to other timber, and in other situations, such as fences, for many posts and rails of the stockade fence here have frequently been found decayed, while in other and older fences, although much worn by time, yet not having been payed or painted, the fibre of the wood remains in a healthy state.

5th. I am also of opinion that skirting to walls, and linings to storehouses and other buildings, if not painted would last much longer, as the damp from behind would then be allowed to evaporate by the action of the external air.

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Cost of Transportation on Railroads. *By* C. Ellet, Jr., C. E.

[CONTINUED FROM PAGE 304.]

On the Value of Time.

In estimating the cost of transportation on railroads I have taken no account, in the preceding numbers, of an item which is generally considered of great consequence in determining the result; viz. *the value of time.* Speed is the peculiar advantage of railroads, and one which is certainly sometimes deserving of much consideration in the administration of the work. I propose to estimate its real value, as nearly as it can be done, in the transportation of passengers and merchandize.

First, then, what are we to regard as the measure of the value of time on any article of merchandize? Is it not the interest on the capital invested in the commodity, at the rate at which the proprietor estimates his profits for the time, added to the rate at which his goods depreciate in value in consequence of detention on the route?

If this be true—and I cannot well perceive what other value than this the *time* lost in their conveyance can possess—let us endeavour to ascertain to what it will amount under different circumstances; and for this purpose we will represent by

r the rate of interest, and depreciation of the value of the goods, per cent. per annum;

P the value in dollars of one ton of the commodity; and

V any velocity of transportation in miles per hour.

There are 8760 hours in a year; and if we represent this number by m, the interest and depreciation of the value of a ton of goods, in the space of one hour, will be expressed by

$$\frac{\mathrm{P}r}{100\,m};$$

and during the time the goods are carried one mile at the velocity V, it will amount to the sum

$$\frac{\mathrm{P}r}{100\,m\,\mathrm{V}}.$$

This interest and depreciation, for any other greater velocity V'. will be for the time consumed in traversing one mile

$$\frac{\mathrm{P}r}{100\,m\,\mathrm{V}'};$$

and, consequently, the difference between the values of the two velocities V and V' (supposing that the time and speed be well employed, and that the engine drivers do not waste at the stations and depots what he gains on the route,) for each ton and for one mile, will be

$$\frac{\mathrm{P}r}{100\,m}\left(\frac{\mathrm{V}'-\mathrm{V}}{\mathrm{V}'\mathrm{V}}\right). \qquad (\mathrm{K})$$

This expression represents the amount which the goods would depreciate while passing over one mile, at the velocity V, over and above their interest and depreciation while traversing the same distance at the velocity V'; or the additional sum which the owner of the goods would be willing to pay to have them carried at the speed V' instead of the slower rate V.

Now let us apply this equation to the transportation of coal, and assume for the velocity V' that which would be likely to have place on a railroad, or ten miles per hour; and for that of V the ordinary speed of a canal boat, or two and a half miles per hour; for the value of the commodity, *three dollars* per ton, and for the value of the capital employed in the trade, 20 per cent. per annum.

How much per ton per mile would the value of a speed of ten miles per hour exceed that of two and a half miles? By the equation we have here

$$\frac{3\times 20}{8760\times 100}\left(\frac{10-2.5}{10\times 2.5}\right)=\frac{1}{48666}\text{ of a dollar,}$$

or a frcation more than the fiftieth part of one mill per ton per mile.

It would appear, then, if this process be correct, that there is but little encouragement to tear the road, and cars, and engines to pieces—augment the risk of accident, and increase the actual cost of transportation 100 per cent.—for the purpose of delivering coal a few hours sooner than it might be effected on a canal at a speed of two and a half miles per hour. If the value of the coal be not more than three dollars per ton at the mine, and the value of the capital engaged in the trade not more than 20 per cent. per annum, the difference to the proprietor could not amount to more than the *fifth part of one cent per ton for the whole time consumed in traversing a space of* 100 *miles.*

Again, let us suppose that the article is flour, of which the value is six dollars per barrel; and let us, at the same time, assume that the depreciation would be 100 per cent. per annum; which is equivalent to the supposition that it would be entirely destroyed if it were detained one year on the passage, and that the depreciation is uniform during the whole period. We will also suppose that the speed on the railroad is infinitely great, or that a mile might be passed by a locomotive engine in a space of time so short as to be wholly inappreciable; while the speed with which the same article would be transported on a canal is, as usual, two and a half miles per hour.

What is the value of the time lost on the canal in this case? Here we have $r = 100$, $P = 6$, $V' =$ infinite, and $V = 2\frac{1}{2}$; which quantities being substituted in the equation yield

$$\frac{100 \times 6}{8760 \times 100} \cdot \frac{1}{2\frac{1}{2}} = \frac{1}{3650} \text{ of a dollar,}$$

or about the *fourth part of one mill per mile per barrel.*

This will be recognized as rather an extreme case; but still it does not justify a high speed,—for three mills per ton per mile is generally not very perceptible among the quantities which enter into the aggregate expenses of a railroad line.

Let us next suppose the commodity to be groceries—such, for instance, as sugar and coffee—of which the value may be assumed at two hundred dollars per ton; and that the interest and depreciation are equal to 20 per cent. per annum. In this case we will find for the difference between the value of a speed of ten miles per hour, and one of two and a half miles per hour—between the speed of a locomotive and that of a canal boat,

$$\frac{200 \times 20}{8760 \times 100}\left(\frac{10 - 2\frac{1}{2}}{10 \times 2\frac{1}{2}}\right) = \frac{1}{730} \text{ of a dollar,}$$

or about *one and a third mills per ton per mile.* The difference be-

tween the value of a speed of five and one of ten miles per hour. would not in this case have exceeded a half mill per ton per mile.

A high speed, then, is not justifiable in the transportation of groceries for the purpose of saving time in the delivery of the freight. If it be adopted at all it must be because the condition of the road, or some other part of the business which it accommodates, renders it imperative, or because the injury which the work sustains in consequence of the greater velocity is not properly appreciated by the parties in control of the line.

We will next take the case of dry goods, of which the average value may, perhaps, be assumed at 2,000 dollars per ton; the interest and depreciation will again be put at 20 per cent., and the respective velocities at two and a half and fifteen miles per hour.

By the formula we have, in this case,

$$\frac{2000 \times 20}{8760 \times 100}\left(\frac{15 - 2\frac{1}{2}}{15 \times 2\frac{1}{2}}\right) = \frac{1}{66} \text{ of a dollar,}$$

or one cent and a half per ton per mile.

This sum is nearly equal to the actual cost of transportation on a road in good condition; and it is therefore apparent that in the conveyance of trains composed exclusively of the most valuable goods, a greater velocity than two and a half miles per hour is always proper; but when it is recollected that there is never more than a very small proportion of the merchandize passing over a line, which possesses anything like the value here assumed—2,000 dollars per ton—the adoption of a higher velocity must still be regarded as of very doubtful utility. Even in the case before us—where the value of the goods is assumed at 2,000 dollars per ton—the difference between the value of a speed of fifteen miles per hour and one of six miles per hour, would not amount to a half cent per ton per mile—a sum which would by no means justify a high speed even if the train were loaded entirely with such goods.

If we apply the same method of computation to the conveyance of passengers, and estimate the average value of the time of all the individuals in the trains, at twelve cents per hour, we shall have for the difference between the value of a speed of fifteen miles per hour and the usual speed of freight boats on canals, or two and a half miles per hour,

$$12\left(\frac{15 - 2\frac{1}{2}}{15 \times 2\frac{1}{2}}\right) = 4 \textit{ cents per passenger per mile.}$$

If the average time of all the individuals traveling be worth twelve cents per hour, the charges on a road where a speed of fifteen miles

per hour is adopted, ***may be four cents per mile higher than could be demanded on one where a velocity of only two and a half miles per hour is maintained.*** Of course there is a great difference between the values put on their time by different individuals; and of course too, there must be much uncertainty in fixing upon a general average. But twelve cents per hour (including the expenses incident to the trip) is by no means a high estimate for the time of all the individuals traveling in the public conveyances; but yet, low as it is, it shows for the value of the time of one person—exclusive of what mere impatience would prompt him to pay—a sum nearly two thousand times greater than that of a ton of coal, thirty times greater than that of a hogshead of sugar, and nearly three times that of a ton of ordinary dry goods, transported at the same rate.

We may perceive, then, why the superiority of railroads is so much greater in the transportation of passengers than of heavy freight; and how it may happen that a velocity which is in the highest degree economical when adopted for the convenience of travelers, may be ruinous when applied to the transportation of minerals and produce. Indeed it is difficult to over-estimate the injury which is inflicted on the interests of stockholders, from the continuance of this evil in the management of railroads, although it has been materially abated within the last four years. The value of the additional time which is consumed at the slower rate is absolutely unworthy of consideration in the conveyance of merchandize; and the only question which ought to occupy the attention of the directory is the reduction of the actual expenses of the line, and the selection of that velocity which corresponds with the greatest possible economy. The great and constant effort should be to reduce the cost of transportation to the lowest limit. It is not railroads nor canals that increase the trade of a country or add wealth to the districts which they traverse. It is the reduction of the charges for conveyance which these improvements permit, from which these great advantages are derived. And high speed on such commodities offers no compensation for the high charges which it exacts.

These considerations are applicable only to the value of time on the goods transported. But the loss of interest, and depreciation of the value of the freight, are not the only losses involved in the adoption of an insufficient speed. The value of the time of the ***train, and of the train hands***, is also to be considered, and enters into the complete expression of the actual cost of transportation. If the engines and cars, and the men who conduct them, do less duty than they might accomplish by the adoption of a higher velocity, the value of the time of the increase of stock and force which will be required to effect the

same duty at the slower rate, must obviously be charged against that velocity.

It is true that there are cases in which the speed to be adopted is governed by the necessity of accommodating a certain amount of trade, or making room for a large passenger conveyance, which could not be adequately provided for on a single track, without maintaining a speed determined by the circumstances. Of course the company must submit to this necessity; they must adopt a high velocity where these or other imperative conditions exact it. But the question now is, what is the value of velocity or time, where they have the power to exercise their own discretion in the selection of the speed?

In all such cases the slower the motion of the train the less will be the expenses of the company, unless it be reduced so low that the interest on the cars and engines which convey the freight, and the loss of the time of the engine and train hands, more than compensates for the reduced charges for repairs of the road and machinery.

We will designate by F the value of the locomotive engine in dollars; by f the value of the stock in cars for each ton of freight; by m' the value of the time of all the hands in the train for one hour; and by q the number of tons of merchandize in the train.

The value of one hour for the whole train will be, at 6 per cent.

$$\frac{6}{100\,m}(\mathrm{F} + fq) + m'; \qquad \text{(L)}$$

and if we represent this quantity by H, the difference between the values of the velocity V' and that of V, will be for each ton, and for one mile

$$\frac{\mathrm{H}}{q}\left(\frac{\mathrm{V}' - \mathrm{V}}{\mathrm{V}'\mathrm{V}}\right). \qquad \text{(M)}$$

This is the difference per ton per mile to the company between the values of these velocities, where no imperative conditions obtain.

Now let us see what value this expression exhibits under different circumstances; and for this purpose we will put $\mathrm{F} = 5000$; $f = 100$; $q = 50$; $m = 8760$; $m' = \frac{1}{8}$, all which are very common values, and suppose, in the first instance, that the business of the line may be transacted by an adequate supply of engines, men and cars, at some exceedingly slow rate—as half a mile per hour—how much more would it cost the company, in the value of time, to carry the trade at this rate, than at a speed of ten miles per hour?

Equation (L) gives us

$$\mathrm{H} = \frac{11}{40} \text{ of a dollar,}$$

for the value of one hour of the time of the train. This value of H being substituted in equation (M) will yield,

$$\frac{11}{40 \times 50} \cdot \frac{10 - \frac{1}{2}}{10 \times \frac{1}{2}} = \frac{209}{20000} \text{ of a dollar,}$$

or more than one cent per ton per mile.

Now, in this case, the value of the time of the train, exclusive of the goods, is equal to half the actual cost of transportation on a well managed road with ample trade; and it is perfectly apparent that, even overlooking the loss of time and depreciation of the price of the *goods*, such a rate is wholly inadmissible. But let us apply the equation to the determination of the difference of value of a speed of five miles and one of ten miles per hour, under the same circumstances. In this case equation (M) gives us

$$\frac{11}{40 \times 50} \cdot \frac{10 - 5}{10 \times 5} = \frac{11}{20000} \text{ of a dollar,}$$

or only one half mill per ton per mile—or less than the tythe of the actual difference of cost—consequent on the destruction of cars, engines and track—risk of accident and damage to goods, incident to the adoption of the greater velocity.

The whole difference between the value of a speed of five miles per hour and one of ten miles per hour, will rarely exceed one mill per ton per mile, in its effect on the interest of the value of the train, together with the depreciation of the value of the goods conveyed. However great, then, may be the inducement to carry passengers at a more rapid rate, there is no sufficient cause for transporting freight at a speed of more than five miles per hour, unless, as already premised, a higher rate is absolutely essential for the accommodation of all the trade which is commanded by the line—a condition which, on ordinary roads in this country, very rarely prevails.

We are not likely to overrate the injurious effect, or too strongly to deprecate the continuance, of the mischievous practice which still prevails in this country in the transportation of heavy commodities. The iron rails are rapidly destroyed by it; the wear and tear of the cars and engines are greatly augmented, and the useful effect of the power applied is materially reduced. There is no corresponding advantage obtained. The value of the time which is saved is almost too small to be estimated for the freight, and the value of the time lost by the train bears no perceptible proportion to the injury which is done to the road and its furniture.

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Railways in Massachusetts. By Alexander Evans, *C. E.*

As the great system of railways in the state of Massachusetts is far advanced towards completion, we are not only gratified with the results of her enterprize, but we look to her for much useful and interesting information, derived from actual experience in the construction and working of her roads.

The following tables exhibit the length, the cost of construction, the cost of repairs and working, the receipt from passengers, freight, &c., and the net proceeds of the principal railroads in Massachusetts during the year 1841.

Table No. 1, exhibits the total number of miles run on eight of these roads, and the cost of running per mile; the cost of repairs of engines and cars, per mile run, and the cost of repairs of road per mile.

The cost of running includes all repairs to engines, cars, and superintendence, and all other expenses properly chargeable to the working of the road.

The cost of running trains on these roads varies from 65 to 107 cents per mile, the lowest being the Western road, and the highest the Boston and Providence, and Taunton branch, which cost the same.

It will be observed that the cost of running on the Boston and Providence road is 107 cents per mile, while that of the Boston and Worcester road, which is nearly of the same length, is about 88 cents; but the distance run on the latter exceeds that of the former, by nearly 67,000 miles.

The number of miles run on the Boston and Worcester road is given in the last annual report of that company, for eleven months only of the past year, or up to the 30th of November; but an approximate estimate of the number of miles run in the month of December, has been made from the income of that month compared with the income and number of miles run in the eleven previous months.

The total number of miles run on this road (adding for the month of December, as above,) from 1836 to 1841, inclusive—six years—is 785,427, and the total cost of running was $\$$703,930, or about 90 cents per mile.

The cost of running on the Western road has been, for the last year, $65\frac{4}{10}$ cents per mile, and for the six months preceding, it was only $61\frac{19}{100}$ cents per mile.

The number of miles run on the Eastern road during the past year, was 191,209, and cost nearly 81 cents per mile.

Bringing the number of miles run on all these roads together, we find the total to be, for the last year, 850,251 miles, and the total cost of running the same, $\$$717,587 dollars, or $84\frac{4}{10}$ cents per mile.

The cost of repairs of cars and engines, per mile run, ranges from 9 to 18 cents.

The cost of these repairs on the Lowell road, the past year, is 18 cents per mile; the excess over other roads may, probably, be in part attributed to casualties and extraordinary repairs.

The repairs for four years, from 1837 to 1840, inclusive, on this road, average $ 14,604 per annum; and for 1841 the amount was $ 22,644, showing an increase of 55 per cent.

By a reference to the annual reports of this company, there appears to have been a great increase of business the last year, and, probably, a much greater number of miles run on the road than any previous year.

The total number of miles run on all these roads, as before stated, is 850,251, and the total cost of repairs of engines and cars, is $ 109,620, or nearly 13 cents per mile.

The cost of road repairs during the last year, for four of these roads, doing a large business, and which have been in operation several years, averages about $ 650 per mile.

On two of these, viz:—the Boston and Worcester, and Lowell, roads, a light rail was used in the original construction, the former weighing 38½ lbs., and the latter 36 lbs. per yard.

Experience has shown that these rails are too light for the heavy traffic of these roads, and the tracks are, consequently, defective, and expensive to keep in adjustment.

In the construction of a second track for these roads, a heavier rail has been adopted, and other improvements made which will, it is believed, considerably reduce the cost of repairs.

On the Boston and Worcester road, there were, at the close of the last year, 70 miles of double track, and the Lowell road has two tracks complete.

The average annual repairs of the Boston and Worcester, Boston and Providence, and the Eastern and Lowell roads, from 1837 to 1841, do not vary much from $ 500 per mile.

The repairs of the Taunton Branch, the New Bedford and Taunton, and Nashua and Lowell, Railroads, average nearly $ 200 per mile per annum, since they were opened for business.

In Table No. 2 will be found the length, total expenditure for construction, receipts for passengers, freight, &c., and the expenses and net income of ten roads in Massachusetts.

The cost of these roads includes outfit, buildings, and fixtures, or the total amount charged to construction up to the close of 1841.

It is proper to remark, that a part of the expenditure of several of these roads, during the past year, is not strictly chargeable to the

cost of operating them, but would with more propriety be placed to the account of construction and outfit.

These, in several instances, are large sums, and being paid out, or deducted from the earnings of the road, considerably reduce the net income.

Eight of the roads embraced in table No. 2, which cost an aggregate of over nine millions of dollars, pay seven per cent. on the capital invested, and the net receipts of several are from seven to nine per cent. on the cost.

The total cost of all these roads is over seventeen millions of dollars; a considerable portion of some of them, however, are not within the bounds of the state of Massachusetts.

The length of the Norwich and Worcester road is nearly sixty miles, eighteen miles of which are in Massachusetts, and the remainder in Connecticut. Nine miles of the Nashua and Lowell, thirty-eight miles of the Eastern, and twenty miles of the Boston and Portland, roads, are in Massachusetts, and the remainder in the states of New Hampshire and Maine.

Statement of the length, cost of construction, number of miles run, and the cost of repairs, of eight Railroads in Massachusetts, for 1841.

No. 1.

* This includes an expenditure of $9,900 for new cars.

† This does not include $14,438 expended in taking up seven miles of track of light (35 lbs.) rail, and replacing it with heavy (56 lbs) rail.

‡ This distance includes Marble Head Branch.

Statement of the receipts, expenses, and net income, of ten Railroads in Massachusetts, for 1841.—No. 2.

Name of Road.	Length of road.	Cost of construction.	Receipts for passengers.	Receipts for freight, mail, &c.	Total receipts.	Expenses of Road.	Net income.
Boston and Worcester	44½	2,374,547	190,097	120,710	310,807	162,998	147,809
Boston and Lowell	25¾	1,834,893	145,953	121,588	267,541	119,469	148,072
Boston & Providence	41 17/100	1,782,000	152,016	78,805	230,821	122,057	108,764
Western	117	5,235,026	113,842	68,467	182,308	104,806	*77,502
Norwich & Worcester	58 9/10	2,157,097	99,332	55,925	155,261	78,805	76,456
Eastern	56†	2,267,033	257,734	41,840	299,574	154,958	144,616
Nashua and Lowell	14½	380,000	75,732	56,764	132,496	95,966	36,530
N. Bedford & Taunton	20	422,758	39,469	13,044	52,513	22,285	30,228
Taunton Branch	11	250,000	52,278	24,646	76,925	55,043	21,882
Boston and Portland		553,289	85,928	30,088	116,016	82,021	33,995

* This road was not opened to the state line until October, and to the Albany and West Stockbridge in December, 1841.

† This distance includes Marble Head Branch.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reply to the writer of the Strictures on the Report and Plans of the Engineer of the Albany Aqueducts. By W. McClellen Cushman, C. E.

In his article in the last number of this journal, the writer appears piqued to have his former effusions considered a harmless batch of fallacies, misstatements and suggestions "pregnant" with very little, if any, meaning—and the more so probably to have them *so proven in detail.* This last, however, can scarcely be looked upon in as favorable a light—for there seems another than the apparent object

evinced throughout this effort; which it is very obvious was intended *chiefly* to serve for (what in politics I believe is called) a "*white-washing*"—of the errors of judgment, fact, &c., existing in almost every sentence of his first critical production.

After opening with an extract calculated to mislead the reader, from an allusion in my last, the writer complacently proceeds to attribute his *own misconceptions* to "the ambiguity of the style of the report." This would seem, certainly, at the very best, a rather lame *argument* on a scientific subject; and were best answered, perhaps, by inviting the reader to compare the styles of our respective articles, and such extracts from the report as the public have been favoured with (of late particularly) by the critic's liberality. But admitting the argument to have no foundation in the egotism of the writer, I beg to enquire in what way it supports the *errors of fact, judgment, &c., volunteered* (of course unassisted by the report) by the writer and his council of "practical friends," as exhibited, in italics, in my reply?

I. The writer next accuses me of "a design to dispense entirely with fire engines!" I have no disposition to set this down as much of a mistake—but it was with short hose that I proposed to produce jets rising to within ten feet of the fountain level *in the elevated district in which the aqueduct terminates,* at which place the head was stated to be fifty-five feet. I have at no time entertained an expectation of being able to force up jets to the *same actual level above tide,* in the *low districts;* but to heights proportionably near it, having regard to the resistance of the air, &c., in abridging the height of jet;* which, however, it is almost needless to intimate, would always extend to elevations much greater than is strictly required for the successful operation of the jets, for the purposes proposed, *throughout such portions of the city.* All this was distinctly enough stated in my reply; and the experiments on the Croton Aqueduct happening just at that time, were adduced as full confirmations of the views advanced in my report—and especially as regards the jets in the upper quarters, where there must, of course, be the most difficulty. I have now before me the late report of the engineer of that work, in which he states, that the jets at Haarlem river rose to a height of 100 feet, which statement does not differ materially from that made in my letter.

More recently still, as at the late celebration, &c., have former trials been again and again confirmed by experiments at the same

* "By no manner of contrivance, however, can fluids be made to issue from a pipe or any other orifice, with the full theoretic velocity due the head of fluid; and the motion of the jet must invariably be still further reduced by the resistance of the atmosphere in its ascent after issuing from the orifice, or pipe. Both these circumstances modify considerably the [height] of jet." Report, page 4.

places, and even at the fountains in the city of New York, &c. Yet the writer appears to consider the *extended experience*, as regards jets, on that work, as not possessing any claims to confidence, in comparison with the *single trial* at Fairmount, which, as was previously shown, was made in *impracticable circumstances!* With due respect for the reputation of the author he quotes, (though without having had an opportunity of examining the principles of his formula,) I must be permitted to say authority can weigh nothing in the face of the *palpable experience* derived from this series of trials, made in *competent circumstances* and on a grand scale—which give full and repeated assurance of the soundness of the views advanced in my report.

The writer imputes (with a flourish) some fanciful discrepancy between the statements of my letter and those of the report, as regards the level of fountain head, &c., in different parts of the city. Now the level at which the fountain head was established, as explicitly stated in several passages of the report, was 260 feet above tide level; and the same fact is inferable at several other places, by the simple process of *addition;* and this head, or level of head, is of course common to all points within the city limits, to which the water shall be conveyed—and this, although the reservoirs which form the *actual* fountain head, are located at the Cohoes, ten miles from the city. The *effective head* at the city, or that which actuates the flow and determines the specific quantity of water deliverable there, is also very distinctly stated, at several places, to be fifty-five feet, and this of course refers more expressly to the particular point at which the *aqueduct proper* terminates, and delivering over its supplies to the city mains for distribution. These latter being, of course, all in communication with the aqueduct and under the influence of the *common fountain head* will give local jets of heights bearing a relation to the depression of their orifices below its level, &c. Much nicer *visionary faculties* than ordinary men possess were necessary, I think, to discover any thing incongruous between these facts and the statements in my letter—the substance of which was, that in the *low section* of the city (which is elevated but little above tide, and gives, consequently, nearly double the head at Haerlem,) we should be able to perform even much greater things, in the way of jets, than had been done at that place, and we certainly shall do this, notwithstanding "the pregnant meaning" of the "facts" and objections the writer has produced.

Not to cavil about an *actual* difference of fifty per cent. between the writer's present and former statements as to height of jet obtained at Fairmount, I have only to say, it was certainly no concern of mine

whether the writer did or did not obtain "such results as might have been expected" *by him;* and it became so at all, only because omitting the essential circumstance of the trial having been made with "a single ajutage of one inch in diameter," he still took upon himself, upon the strength of that "indirect fact," the responsibility of deciding upon the feasibility of my plans for applying the head of water as a power, to the extinguishment of fires; which plan had reference "to an appropriate orifice for the jets," the copiousness of the supply of water, and contains other evidences of *respect for the laws of nature.* How the writer could do this upon the strength of a *single trial* made in *violation* of all these indispensable requirements, unless by mistaking his "stubborn fact" for a "principle"—in other words by evincing that he had no knowledge "of any such requirements," is a question for the candor of the public to decide.

The influence of the ordinary consumption of water upon the head in *standing pipes,* as instanced by the writer at the Navy Yard in Philadelphia, is perhaps one of the peculiar features of the plan on practice in that city. At any rate the essential independence of the jets of this city, is insured by the *location* which I have given the line of the *aqueduct proper within the city limits;* and it does so by determining the order in which the different sections will derive their supplies. It is in this way that the ordinary supplies of the citizens will "go on at all times when it is required," without sensible restraint upon the jets.

I did not propose to rest the safety of the city "upon the possibility of catching fire in its inchoative state," (meaning, it is presumed, when a fire first breaks out.) The writer unwarrantably assumes an intention on my part of dispensing entirely with the use of ordinary hose. Quite the contrary: the system of "short hose attached to the hydrants," forms the means of producing "an almost instantaneous effect," before "ladders, lengthy hose and a competent force to manage them could be provided,"—but which, *on their arrival,* could also be *attached to the hydrants;* and co-operate just as at present; and serve for *casting on water* at all points and in all positions within the reach of moderate jets; and always for *delivering* water at every accessible point, up to the roofs of the most elevated buildings in any quarter of the city. Nor must the system of pipes "for domestic and economic purposes," capable of delivering water into the "highest chambers," and (with the surplus head) even *above* the roofs—be supposed to play an insignificant part in the general plan.

Such is an outline of the system contemplated; which, while it will relieve firemen from the almost super human efforts they are now required to make, *in forcing jets by means of engines*—and often even

then without the power of staying the progress of devastation—will at the same time be able to arrest even the most "considerable conflagration effectually and expeditiously,"—even could we suppose such conflagrations either probable or *possible*, with such means and appliances at hand.

The writer feels "impelled to the conclusion" that I *must* have meant to restrict the size of the orifice to one and a quarter inch, &c. Whether the impelling power in this conclusion is or is not attributable to the limited inventive powers of the critic, I leave for others to judge. He is, however, as greatly mistaken in this as in most other "conclusions" of his. It appeared to me a very easy matter to manœuvre short hose of even pretty large calibre, and with orifices as large at least as the body of the common hose; and having satisfied myself from some observation and an attentive examination of the results of Mariotte, and other experimentalists, that *with orifices approaching this size*, it was perfectly practicable, on this general arrangement, to throw up jets of the height contemplated in my report, I left the *exact size* to be determined by trial when the aqueduct should be put down—intending to use just that size which should prove to be just adequate to produce the required effect as local jets, —comparatively small orifices, &c., being practicable in the districts of inferior level, where the *supply* of water, &c., would be greatest.

III. As regards the "fatal doctrine of one-twentieth of an inch," &c., I must request whom it may concern (and every city and flourishing village in the Union is deeply interested in the means of obtaining *abundant supplies of pure and wholesome water*, on an efficient and at the same time economical plan) to recur to my late reply, to perceive at once, and clearly, that the *actual thickness* of metal assigned the conduit, was *more than adequate* to support, *permanently*, the head it will be required to sustain—the conduit at Haerlem river having been actually working, for months, under "less than the equivalent of one-fourth of an inch for a seventeen inch pipe," &c.

The writer, however, disdains to notice the *practice there*, with tubes of twice the size of those at Philadelphia, (thirty-six inches is, I believe, the calibre) and with every thing else on a much greater scale. The reader will look in vain in his last effort for any reply to, or notice of, this *decisive case* of practice—which was adduced in my letter to show the "error" of *judgment* under which he laboured, in regard to the "*real results* of practice," &c.—and this, although he appealed so unreservedly in his first critical essay, *to practice*, as the *only criterion!*

But a grand reason for finally settling upon this thickness in preference to any other, was not from any misgiving as to strength, but

that it was conclusively settled, in my mind, that castings of one-twentieth of an inch *could not be executed*, nor indeed of any *less thickness* than the *fourth* of an inch, except by actually enhancing the cost of the work,* which of course left no rational motive for adopting any higher dimensions. I was subsequently fully confirmed in the propriety of this opinion and decision, on consulting with founders of skill and experience—whose opinion on such a point merited every confidence.

On some future occasion I shall, perhaps, find a convenient opportunity to enlarge upon the relations which should subsist between the diameter and thickness of metallic pipes, in order to sustain a determinate pressure, &c., and the writer is assured that I will then find it quite easy to establish the adequacy of the least thickness stated in the report, as regards capacity to sustain a *working head of fifty-five feet;* and, consequently, its suitableness (with some allowance for unavoidable corrosion, &c., before being laid, and, perhaps, in the first stages of the operation of the works) for the purpose, but for the practical difficulty in the way of executing the castings—quite as easy indeed, as *I have been* successful in demonstrating by *practice* that the actual thickness of metal to be put in the conduit, viz. one-fourth of an inch,† is at least *more than is really necessary.*

In the mean time I beg to remind the writer that he has not been "good enough to define what degree of excess of thickness will always make pipes secure when they fail only at imperfections," and will now, if he pleases to accept easier terms, reduce the challenge simply to failure of sound castings.

Regarding "the contingencies from without," and the *theory* of the writer as to the mode in which he deems pipes to be injured by the pressure of the earth which covers them—even admitting that any engineer of sound practical views can be found to concur in this theory, remedies for such contingencies are so easy, in my view, as to make any objection founded thereon quite frivolous.

V. This appears to be nothing more than tautology—a repetition of part of the preceding article.

VII. It would be a sufficient reply to the writer's *theory* as to "the momentum not being kept up while the piston clears the dead points," &c., to remind him that the proportions and play of the pumps, and

* "I do not think, however, that economy would be consulted in reducing the thickness below one-fourth of an inch; although, of course, with this calibre, the pipe would, *as far as strength is required*, bear a reduction of its thickness." Report, page 25.

† "The Philadelphia conduits being two-thirds of an inch thick and the Albany one-fourth of an inch, the quantity of metal in the latter is five-eighths, or 62 per cent., *less;* which prodigious economy of the costly material of which they are made, it will be observed, is *exclusively* the effect of *plan.*

other members of the elevating machinery, are *all essentially different*—the works at Fairmount not having been taken as my model: and that a Watt, a Smeaton, or a Fulton, would most probably also have presumed so far as to differ with the writer in his *entire admiration* of the plan of the works at Fairmount; and would probably have preferred to draw pretty largely upon the reservoirs of their own genius and skill. But is it not true that the works at Fairmount have several pumps worked by one shaft, and discharging into a common main or force tube? If so, does not such an arrangement *virtually* annul the effect of dead points? The theory of the writer seems to me to *fail* entirely to account for the destructive effects observed by the superintendent of those works.

The writer seems not yet to have discovered that *the conclusions* from facts, practice, and experiments, are often very absurd and improper; or that there is a pseudo false philosophy of this description which is an extremely fertile source of "error." In this way has he, I think it probable, mistaken "*theoretical conclusions*" for "experimental results of a very significant character;" and although such results should not perhaps be entirely "disregarded," still *practical men* may I think be permitted, (without incurring the imputation of "not feeling a proper anxiety for the success of works committed to their charge) to credit them only for just what they are worth. *

* * * * * * * *

In concluding I must take occasion to say that any critical remarks made in my report, were quite general in their character—no particular work being specified; that none were made which could well have been omitted, or which were not absolutely necessary as arguments to show the propriety of the plans I proposed, &c. If, therefore, any thing unkind has been said, or "odious comparisons" made, in regard to the Fairmount works, or the city conduits, or any other work, in the progress of this controversy, the thanks are due exclusively to the writer of the criticism on my report,—who rendered the special allusions necessary for its proper and just vindication.

* The next paragraph in the MS. of our correspondent, containing personal remarks, which can have no bearing upon the question in controversy, has been omitted. Indeed it is to be regretted that better temper has not been displayed in the whole conduct of the discussion, since both of our correspondents, doubtless, look to the same result—the establishment of what they believe to be truth, and the cause of truth is neither aided by harsh language nor personalities. COM. PUB.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Practical Experiment made by M. Fourneyron, to show the superiority of a Turbine over an Overshot Wheel, both using the same quantity of water, and working under the same fall.

The second turbine which I established was not tried with the friction dynamometer; it was not necessary here to prove to the proprietor for whom it was constructed how much it returned of the power expended, but only to show, that to produce the same effect, it consumed less water than other wheels, and that it turned under water sheltered from the frost,* and was but little affected by variations of level.

For this purpose, the turbine was placed under the same fall that drove an overshot wheel, which had been established some years, and which worked with the required velocity the pistons of the blowing machines of a furnace, which my turbine also was to drive.

One wheel was put into gear, and the other disengaged, while the opening of the sluice gate was regulated so that the expenditure of water should remain the same in both cases.

The overshot wheel was run sufficiently long for its motion to become uniform, and the strokes of the piston were then counted. The turbine was then put into gear, the other being thrown out, and after having run some time, the strokes of the piston furnished by it, were also counted.

The following were the results:

When the blast of wind vented was under 13 or 14 cubic metres (489 to 594 cubic feet) per minute, the two wheels (overshot and turbine) to produce the same effect, consumed the same quantity of power, for the turbine had then a velocity, and a width of gate drawn which were very small.

On the contrary, in proportion as the opening of the gate and the velocity increased, a greater blast was produced by the turbine than by the overshot wheel, all other things being equal. Finally, when the turbine worked under the influence of the conditions of its establishment, or those for which it was planned, the effect produced notably exceeded that of the overshot wheel with which it was compared, which was in good order and had been well constructed. This overshot wheel, a single arm of which weighs more than the whole of my

* The great ease with which the turbine of M. Fourneyron can be sheltered from the *effects of frost*, will be readily appreciated by all practical men, who have had the management of water wheels in a northern climate, for it is quite evident that either by running the turbine in a close forebay, within the body of the mill, or by immersing it at will to a suitable depth *in backwater*, (as was done by M. Fourneyron, with a fifty horse wheel at Fraisans, in France,) this peculiar water wheel *may, with ease, be effectually protected from ice.* M.

turbine, (whose weight is only 80 kilogrammes, or about 180 lbs.,) *is not susceptible of producing a power greater than three-fourths of that of this small wheel,* as was ascertained by the maximum blast produced alternately by each.

To show the facility with which it works under water, we immersed it to a depth of $1 \cdot \frac{20}{100}$ metres, ($3 \cdot \frac{94}{100}$ feet,) when it continued not only to give the necessary blast, but also made the overshot wheel revolve in the backwater. This wheel, though it received no water from above, while the turbine made it turn, yet without load, and whilst receiving all the water it could use, it had difficulty in taking a velocity half as great as that communicated to it by the turbine.

I know that these experiments, if they were isolated, would not be conclusive as to the utility of the machine, but I had to address myself to the eyes of a practical man, who judged better by experiments of this kind than by the use of a friction dynamometer, of which he did not understand the application.

Desiring to demonstrate, by figures, the superiority of the turbine over the wheels usually employed, I proposed to him to submit it to the trial of a brake, before I constructed the larger one, (of 50 horse power, at Fraisans,) which he was about to order; but being satisfied as to the results, after a few months' observation, he no longer delayed to intrust me with the construction of the' large turbine which I have recently completed.

Bulletin de la Société d'encouragement pour l' Industrie National.

Franklin Institute.

Address delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842; by A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

The traveler in the deserts of Syria, resting at one of those few favored spots where the turf shows the presence of the refreshing well, and the date palm gives him shade, finds himself amid the ruins of a great city. Broken columns—architraves, and fragments of pediments half imbedded in the sand—heaps of ruins, indicating the former existence of massive structures, and deluding him with the idea that even now he may trace the extent and form of the space once occupied by the dwellings of men—all speak of the magnificence, the grandeur, and the vastness, of a great commercial capital. He is amid the ruins of Tadmor of the wilderness, Palmyra, the great commercial emporium of former days—now part of the greater desert. Here was once the entrepot of the commerce of the East and West, and here arose a city—as it were one vast temple to that commerce which linked together the far East and West.

Amid the lagunes and marshes at the head of the Adriatic, the gorgeous fane and splendid palace are reared, and the varied ornaments of a florid architecture are lavished to decorate the homes of the merchant nobles. The very difficulties of the site are made to contribute to luxury; no noise of wheels disturbs the quiet of home, or the hum of business on the Rialto, but the luxurious gondola glides silently through the vast canals which connect the distant quarters of this queen of the sea. Commerce has been again at her work. Civilization has advanced westward; and while Tadmor is crumbling, and the sands of the desert are gathering over its ruins, Venice is rising from the waters, the new entrepot of commerce between the East and West.

A new route is discovered, by which the products of the agriculture and arts of India are conveyed to Europe; commerce departs with prosperity in her train, and Venice is given over to the destroyer.

In the early periods of history these changes were few, their progress was gradual, like the slow changes of the scenes of a diorama; ages elapsed before the tide ceased to set through Palmyra. In modern times the changes are like those of the kaleidescope, sudden and striking. Agriculture changes its objects or its methods—manufactures spring up and flourish, or decay—the arts find new seats and new subjects for their exercise—commerce, which connects the producer and the consumer, runs in new channels. Cities greater than Tadmor or Venice spring up, the creations of a new civilization.

Increased production, whether in agriculture or manufactures, is so obvious and powerful a source of prosperity to a country, that we naturally look with interest upon every circumstance which may effect it, endeavoring as far as may be, to understand, that we may aid. While all are agreed as to the necessity for cherishing agriculture, manufactures, the mechanic arts, and commerce, as the essential elements of national wealth, few agree as to the means of protection. One would think that by this time facts enough had been accumulated to settle all doubts, and to establish a science whose principles should be as well ascertained as those of the philosophy of nature. But the passions, prejudices, and interests of men must be overcome before they desire to find the truth; and then all the difficulties remain of interpreting the results of complex experiments, and of assigning the just influence to each of their numerous and varied attendant circumstances.

It is conceded in every civilized community that the products of its agriculture, manufactures, and arts, should be brought as nearly as possible to perfection, and that improvement is the necessary consequence of the increased intelligence of those who follow the various callings connected with them. Avoiding, then, debated and debatable ground, and planting ourselves upon that which is fully and fairly our own, it may be profitable for us to consider *the means employed in different countries for the promotion of manufactures and the mechanic arts, and of the intellectual improvement of their cultivators.*

—his general survey, we may derive materials for a compara-

tive estimate of our own efforts—encouragement it may be, or stimulus to increased exertion;—hints of new lines of usefulness, or assurance that perseverance in those in which our efforts are already directed, will ultimately be crowned with success. In a country like this, where public opinion makes, alters, or repeals, the laws, there is always reason to hope for the success of what is right. It may not come this moment, nor the next, but as sure as the darkness of night heralds the approach of dawn, which certifies the coming noonday, so surely will truth finally prevail where public opinion rules.

The principle of voluntary association by which, in the United States, we obtain some of our best results, is derived from the country to which we owe our origin. It is imperfectly understood on the Continent of Europe, and is but feebly applied even in those countries where a semblance of political freedom exists. The government too often assumes the power to direct the mind and to control the will.

PRUSSIA has undertaken to show what an "enlightened despotism" may effect, and the results of her combined educational, military, political, and religious system, yet remain to be fully developed. The rulers have had their preferences in regard to the encouragement of different departments of agriculture and the arts. At one time, the silk culture, and the manufacture of silk and porcelain, were especially patronized; at another, brass and iron founding, and the culture of the beet, and the manufacture of sugar from it. The minutiæ to which the government descends, may be perceived from the fact that licenses to follow trades and occupations, the results of which concern human life, (as those of the druggist and chemist, of the architect and builder, of the mason and carpenter, and even of the well-digger,) can only be had upon an examination upon certain preliminary acquisitions, deemed essential to the prosecution of each.

The recommendation of general measures for promoting the interests of the useful arts, is entrusted to a technical commission connected with one of the departments of the government. A society is also permitted in Berlin which takes cognizance of inventions submitted to it, which meets at stated times to discuss reports upon alleged inventions or improvements, and under the nominal patronage of which a monthly journal is published. To provide for the technical instruction of those who intend to follow mechanical employments, schools have been established in many of the provinces, to be entered after the usual period of elementary instruction is passed, and before an apprenticeship is commenced, or during its first years. The most promising pupils of these schools are transferred, after serving a portion of the time of their apprenticeship, to a central school, at Berlin, where they receive, free of expense, instruction in the branches which may fit them for the occupation of machinists, founders, and the like. Architects, builders, and engineers, have a similar public institution, for the preparation of the members of their professions. The Trade Institute of Berlin turns out annually a class of well educated young men, whose influence on the occupations which they embrace, must ultimately be of the highest benefit.

The plan and execution of that great scheme of uniting the States

of Germany, once loosely connected by political ties, in a commercial league, is due to Prussia, and now the toll-league embraces nearly all the States of the old German empire, except Austria. A uniform scale of duties is adopted by all, and import duties are collected at the frontiers, to be distributed in proportions agreed upon by the several parties.

Austria has *her* way of encouraging manufactures and the mechanic arts, different from that of Prussia. Her manufactures of porcelain, of iron, of linen, of sugar, and of chemical products, have in turn been aided. Her quicksilver mines and porcelain manufactory belong to the government, and the former are worked by a corps specially organized for the purpose. The government has established trade schools, like those of Berlin, in some of the provinces, but their great *Polytechnic Institution* is in the capital itself. No expense has been spared to collect in this establishment the best specimens of the materials used in the arts, of the tools and machines (or models of them) employed in the different manufactures, and of the products of industry. All are used for the purposes of instruction in the technical schools, and are accessible to the mechanic. One portion of the immense structure is occupied by the rooms devoted to these collections, and to models of architecture of various kinds and of different countries. In one of them is a model of that admirable structure, now lost to us, the work of an American mechanic, the wooden bridge at Fairmount; and it would be curious if one day a Philadelphian should bring back a copy of it, to place in the hall of the Franklin Institute of Pennsylvania.

The late emperor, when heir apparent, vieing with that department of the government which had charge of the polytechnic school, collected for himself a vast museum of materials and products of the arts, presenting not only the results of Austria, but of the world—a standing exhibition of the works of the useful and decorative arts.

The stranger must be struck with the magnificence of the pile thus reared by imperial munificence, as the temple of the useful arts—and as entering the spacious gates, he passes through the halls devoted to elementary instruction in science and languages, to the higher branches of practical science, through the laboratories only rivalled by one among ourselves, through the extensive range of rooms for the display of materials of the arts, of models, of fabrics, of machines—through the work-shop, whence some of the most accurate instruments have proceeded—through the immense galleries, devoted to a standing exhibition of the arts, manufactures, and agriculture of Austria—he cannot but admit that in *this* at least the government has wisely appropriated the means derived from the people for the people's good.

It is admitted by all, that in the arts depending upon chemistry the existence of that institution has already produced important effects, and it is generally believed that the view there afforded of the comparative essays of different manufactures has led to the improvement which the products of Austrian industry have exhibited at the German fairs.

Whether practical instruction in the workshop should precede or follow the theoretical instruction of the schools, is a moot-point. An intelligent iron master of Styria thought he had found the true solution to the problem, by bringing up his sons, from the time of finishing their elementary education, at the forge and furnace, and at the end of their apprenticeship sending them to the technical schools. On the contrary, the Prussian educates for the workshop in the school, requiring each pupil to go through a course of practice there—and in Dresden, the apprentices who are pupils of the Saxon Trade School, work during a part of the day, and receive their technical instruction during the remainder, thus mixing theory with practice.

We may admire the efforts of the Austrian and Prussian commissions, but after all, the plodding spirit of routine which clogs the limbs of activity in these countries, renders the measure of success of the plans *there*, no scale to judge of what would be accomplished where the load of despotism was not to be borne forward.

France has halted in her scientific career since the youth of the nation have drunk so deeply of the excitements of political life. In Paris, the periodical exhibitions of the manufactures of the kingdom, are doubtless not without their influence. The Conservatory of Arts and Trades—a fine array of models and machines—chronicles the various improvements in each branch of art. The lectures of its eminent professors spread before the student the scientific principles which he is to use. A few members in the National Institute give a representation to the arts. But these are acquisitions of a past day. The trifling public aid extended to the School of Arts and Trades in Paris—the stationary condition of the Sevres porcelain factory—the diminished glory of the Gobelins—the attacks in the Chamber of Deputies upon the Industrial School of Chalons—do not speak of progress in the old way of government support, and no new one has come into operation to replace it.

It would be easier to generalize in regard to the United States, extending as it does through twenty-six degrees of latitude and eighty-three of longitude, than in relation to the small territory of Great Britain. If an Englishman's house is his castle, his workshop is its citadel. The establishment of Bolton & Watt is not open even to strangers, and strangers may pass into many not accessible to townsmen. Keen competition keeps men much asunder.

The Manchester man would care little for an exhibition which would bring to his town the iron of Glasgow, or the cutlery of Sheffield. Besides, neither his customers nor his judges are to be found at home. Rodgers displays his cutlery in his shop, because all great manufacturers have a show room; but he looks to America for his gains, and his agent in London occupies a small shop in an obscure street. Mackintosh cares little whether the colours of his dyes suit the "Glasgow folk" or the "Edinboro' gentry" or not, and Strutt does not make his woolens for the consumption of Derby.

The home market is comparatively of little importance. Every man endeavours to improve as fast as he can, to surpass his neighbour—to keep, as far as he can, the ascendency which skill, or talent,

or capital may have given him. The attempt of the British Association at Newcastle to bring together the products of the arts and manufactures, was but very partially successful, and it was thought that if this had been made by practical instead of scientific men, it would have failed entirely.

Are we to infer from this, that exhibitions andcollections in the arts, and the diffusion of knowledge in regard to them, are all useless? England is the workshop of the world. To what purpose do we toil to promote that which can and will take care of itself? Let us examine this argument a little. Are we sure that things might not be better under a different system, even in England? Who shall say what progress the English manufacturers and mechanics might have made, had their energy been aided by greater publicity—by greater facilities for comparison? One thing may positively be affirmed, that no patriot would exchange the neglect of education on the part of many of their opulent mechanics and manufacturers, of self-improvement out of the immediate line of the workshop, of good manners and address, for the strikingly reverse trait which obtains among so many of our men of equal resources in the arts. Education make a mechanic! says the objector. Watt was educated a surveyor—Arkwright a barber—and yet the one was the great inventor of the useful form of the steam engine, and the other of the jenny. What use of schools for special instruction in mechanics? This objection might, perhaps, have some force, if all men were Watts and Arkwrights, if there were no *common* minds to train. It would have more force if there were no education but to make certain forms of letters, and to construct sentences, and to add numbers. Away with such limited views of education! Were Watt's powers of observation and reflection not educated? Were Arkwright's powers of invention not educated? Their lives show how *the circumstances in which they were placed educated* them for their very inventions.

But if this argument is worth any thing, it is worth carrying to its full consequence. Because Burritt was brought up a blacksmith, Lukens a farmer, Baldwin a jeweler, Merrick a merchant, and Morris a druggist, we should make linguists by putting our sons to the anvil, mechanicians by requiring them to follow the plough, builders of locomotives and steam engines and machine makers by apprenticing them to the details of filagree work, of accounts, or of pharmacy. This seems the legitimate inference from the argument of those who, because English manufacturers and mechanics are great in their lines, would eschew schools, lectures, cabinets and exhibitions. Ask the men themselves whom I have referred to, how *they* would desire to educate *their* sons—how they would wish to have been educated, were their lives to be passed over again. Hear from them the difficulties which they have encountered for want of a different schooling. Hear from them the circumstances which have really given them their schooling. The school of life and practice is one of the hardest in which men are educated. Men who are educated in it are planting in growing time, and may be considered happy indeed if they reap before winter.

But have no attempts been made in Britain to improve the mechanic as an intellectual being? Professor Anderson, of the Glasgow University, dissatisfied with the narrow regulations which constrained the institution to which he belonged, left by will his apparatus and a small legacy to found a more liberal school. Dr. Birkbeck endeavoured to make this small foundation available for the instruction of mechanics, and classes were opened for their benefit in the institution. Voluntary associations of mechanics, under various titles, sprang up under the direction of Birkbeck and his associates, and for a time promised great things in the culture of both the adult and the youthful mind. They usually combined public lectures in chemical, mechanical, and general science, and classes of mathematics, of English, modern languages, &c., for the sons, wards, and apprentices of members. Many of them are still in existence. Some have taken root, but are found to be supported more generally by merchants of various grades than by mechanics. From the example of these associations, others for very popular instruction have been established, giving lectures at moderate rates on geography, history, and the elements of natural science.

Some of the institutions for the promotion of the arts award prizes for special excellence in particular objects to manufacturers and mechanics, and also to the successful pupils of their schools. The Society of Arts of London, and that of Scotland, give premiums for meritorious inventions submitted to them; have papers read before them, by members, on new inventions, and the former association publishes its transactions. Each has a meeting for the public award of premiums. The Royal Institution of London, at its Friday evening meetings, calls frequently on mechanics for lectures, explaining their arts and trades, and the improvements in them. These and similar efforts contribute to diffuse and to increase knowledge. If the results seem to be small, lost in the great stream of improvement which ever flows onward; yet in mingling with it, they impart at least some small motion to its mighty mass. The collision of mind with mind that takes place in these numerous associations, is of high importance; the tendency is to make men aware of their own deficiencies and to furnish a motive to supply them, to liberalize the feelings, to promote mutual confidence, and to produce esprit de corps. These results are of inestimable value in the aggregate.

The low wages of operatives generally in Europe, low relatively to the prices of conveniences, tends to keep the mass of them from intellectual improvement. Their youth is passed before they can judge of the necessity for culture, and when manhood is reached, the cares of providing food and maintenance for themselves, and usually for a family besides, press upon them so heavily, that they have time to think of little else. Until the means of life are more uniformly distributed, the mass of the mechanical population of Europe cannot become intellectual. The advantages of a different system of things, which exists with us, we should never lose sight of—never let go. It is not true that the necessaries and comforts of life are higher with us in the same proportion as our wages. The life of the

American working-man is not that of the European. Besides that his inestimable political rights put him on a par as a citizen with every other citizen, he occupies a different place in the social scale—may, by education in school and out of school, put himself on an equality with any other citizen—and may have comfort and competence for himself and his family. Thus relieved from the grinding pressure of want, wo to him if he slight the privileges bestowed by a bountiful Providence! Wo to him if he forget that he has a mind and soul as well as a body—an intellectual and moral as well as a physical nature!

Which of all these plans, devised by the intelligence of so many minds, for the *improvement of the useful arts, and of their cultivators,* have we followed out? What new paths have we opened? What success has attended our exertions? Voluntary associations for the improvement of agriculture, manufactures and the arts, exist all over our country, not supported, it is true, by our great sovereign, the people, but by a few, who are either immediately or remotely interested, or who desire to advance the weal of their country. If the eyes of this most august sovereign might but be opened to the importance of fostering these institutions! If for the improvement of the mass, he would but contribute a little of what he lavishes in raising up the political princes of the land! In the olden time, the commons of England gave every ninth sheep and every ninth fleece to their ruler, to enable him to wage war; now a large portion of our commons devote at least the ninth penny to king Party, to enable him to carry on the strife political. Would that they would spare the ninth part of this to put down ignorance and elevate virtue!

In different parts of our country, the modes of action intended to accomplish the great ends to which I have referred, have been various, and attended with very different degrees of success. It will be more proper, as well as more profitable, to look specially to our own doings.

What have *we* done to advance the progress of the useful arts? First, what have been the results of our exhibitions? The same which experience all the world over has shown to result from them. But will it be said by any one, however enthusiastic, that the contrast between the meagre show in the Carpenter's Hall, at our first exhibition, in 1824, and the brilliant display which is just now terminated, is due to these exhibitions, or to those in Philadelphia, New York and Boston, combined? Let us reply by another question. Would we, or would we not, have arrived at the same point without these annual or biennial shows? I answer unhesitatingly, No! It has been remarked of exhibitions of specimens in the arts elsewhere, that though the same artists produce the specimens, there is a steady improvement in them. The taste of the public is improved by them—the taste of the artist is elevated. So, here, observe from year to year the growth in taste of the judges of the different articles submitted at the exhibition, and of the depositors, who are the venders of the manufactured articles. What a powerful reaction must be produced by thus furnishing the vender with the means of accurate comparison, the conclusions from

which he may communicate to the manufacturer. Observe the public generally, how the admired articles of one year are the rejected of the next! Listen to the remarks made upon those branches of industry which are stationary. To deal with history instead of what is present; turn to the exhibition of two years ago. Take a branch of manufacture then dead, and compare the effect produced by the well preserved mummies of specimens, though carefully washed and well placed for show, with the results of their first living appearance. The glazing and gilding are untouched, the colours of the painting are as bright as ever, the designs just as tasteful as they were when first exhibited; but the taste of the public is improved, the specimens are returned to their cases, their interest for the future is purely historical —they are deposited among the archives of the arts. The influence of this improvement in public taste alone is not to be rejected.

It is obvious, then, that there are reasons why exhibitions should contribute to *aid* that which requires other causes to support. If they neither form the foundation of the building, nor yet its superstructure, they serve to determine its shape and the arrangement and distribution of its parts.

The influence of the medals and certificates awarded at these exhibitions is much undervalued by many, who, looking merely at their intrinsic value, consider them as so much silver or paper. They would value in the same way expressions of esteem as so much breath. The great dramatist has sufficiently held such persons up to ridicule by putting their argument touching honour in the mouth of that impersonation of all that is ludicrously contemptible—Falstaff. These testimonials have, however, a value in dollars and cents, which, though *I* cannot precisely estimate it, others may. Those who know enough to be aware of their own ignorance, look to others who have knowledge to guide their opinions. Thus the opinions of the judges, expressed at the exhibitions, become the guides of many and many purchasers, who seek or reject, not according to their own judgments, but according to the decisions of the Institute. Rely upon it, these exhibitions and the premiums awarded at them, have a powerful action upon the consumer, the vender, and the manufacturer, and through them upon the arts.

These periodical exhibitions are times of high excitement in the Franklin Institute. The public is called in, and the members are their entertainers. The fly-wheel of the institution appears to have been thrown out of gear, and the motion is rapidly accelerated. It could not exist under a long continued action of this sort. Why should not provision be made in the ordinary and regular working of the Institution for a constant exhibition? Why should all these products once collected be dispersed, never again to be re-united? Like the Conservatory of Arts, of Paris, or the Trade Institute, of Berlin, we should find such a collection a chronicle of the history of each art in our country. As in the Polytechnic Institute of Vienna, we should find by the side of models and machinery, the raw materials and products of our manufacturers and arts, from the date of their introduction, or use,

to the day of exhibition. Were our *Sovereign* prepared to erect the piles of the Conservatory or of the Polytechnic school, we should easily find articles to fill their ample halls,—and is it impossible that this should ever be? Look at the structures raised by the public for education. Who would have believed forty years ago, that such would now exist by the means which have raised them? Voluntary association may do much, but not everything. The desire to accomplish this, among other purposes, led to the attempt to extend the accommodations of the Institute in 1835. Perhaps under other circumstances we might have succeeded. Had the tide continued to rise, instead of beginning to fall, we might have passed the shoal, and found ourselves in smooth water on the inner side. We may now be satisfied that having ventured much for a great good, we are still safe. This branch of our Institute must bide its time. Meanwhile, the exertions of the Professors and members are forming the nucleus of cabinets of models and products of the arts, which promise to become of value; and the steps taken by the Managers to obtain from depositors specimens of those articles which take premiums or certificates, where the nature of them admits of it, will, if met in the spirit of liberality by the contributors, soon secure a useful and large collection. How interesting a view would have been presented of the progress of American arts, had such specimens been collected at all our Exhibitions! And while on this theme, does not memory call before us one dear to the Institute, as among its earliest friends, its founders, its first Professor of Chemistry, who made the earliest beginning of our cabinet of arts and manufactures, whose zeal and judgment connected him with our best and most useful efforts—though removed from us by death, he lives in our affections, and his name will be perpetuated in the history of our Institution. We already begin to have a history. Already the obelisk is raised, upon the base of which the names of the useful, zealous, and able, among the members of the Franklin Institute, are to be inscribed at death—that tablet bears even now the names of Keating and of Ronaldson.

The awarding of premiums for inventions, though distinctly different in part of its operation from similar awards for the best specimen of any art, owes its efficacy to the same principles. It is not the value of the prize, but the value of the opinion, which causes the inventor to submit his designs for examination. This consideration of inventions forms part of the everyday business of the Institute. Formerly it was done by the Committee on Inventions, and now by the Committee on Science and the Arts, formed by the voluntary association of the members of the Institute. The time and capital which have been saved to projectors, and to those who furnish them with means, through this Committee, are not the least important of its results. Men who were flattered at home with the idea of being Fultons and Watts, have found that, after all, Fultonism is not so easy of attainment, and those who were prepared to embark their means in schemes, have been saved both money and chagrin. Our countrymen are yet favored, occasionally, with the *novel and astounding* sight of vessels torn to pieces by the destructive agency of gunpow-

der, fired by the also *novel* method of a wire, heated by means of a distant galvanic battery—and all at the expense of the United States. With the explosion of unexplodable boilers, or of some old fashioned way of preventing this catastrophe. These things merely indicate, perhaps, a plethora in the National Treasury, or, perhaps, that all knowledge is not given instanter, upon being elected even to high political stations. But, seriously, the award of the Scott's legacy medal and premiums, which our City Councils have delegated to the Franklin Institute, is the source of much usefulness, and, coupled with the opinions given by the practical and scientific men who are united in the Committee of Science and the Arts, has worked good to the arts, their cultivators, and their patrons.

In nearly all the institutions abroad to which I have referred, the publication of a journal in which to record inventions and improvements in the arts, and discoveries in the sciences which bear upon them, is regarded as of high importance. It is obvious, indeed, that this is the only effectual mode of diffusing a knowledge of improvement over a wide space. In days gone by, the mechanic of Continental Europe passed part of his apprenticeship in wandering from place to place, to practise his art, as a means of support, and gathering the improvements which might have been made in it, to turn to account on his return home. Now the Journal brings to his door the improvements of the most distant places, with all the rapidity which steam navigation and railroad transit can give. There can be no doubt that of all the means of usefulness of the Franklin Institute, the publication of its monthly Journal is most widely operative. Its readers find a chronicle of the ingenuity of our country in the patents recorded in its pages, while they find the wheat separated to their hand from the chaff, winnowed by the labors of one who brings knowledge unsurpassed in this department to the execution of his work. Copious extracts from foreign journals convey the improvements of Europe to our mechanics and manufacturers, while original articles from our own mechanics, engineers, and men of science, contribute their full quota to the interest and usefulness of the work. It was early determined by the Institute that such a journal must be maintained, and the present periodical, originally commenced by the Professor of Mechanics, was adopted. The expensive nature of the work, its low price, and the limited support which it was likely for many years to receive, forbade the idea that it would be a money-making undertaking; and the Institute has been satisfied to support it, as a means of usefulness, at a small annual loss in money. But, for a feature characteristic of the enterprizes of the Franklin Institute, there can be no doubt that this undertaking would have been onerous. Whenever a line of labor likely to benefit the public has been pointed out, and a scheme for rendering it available has been well matured, members have been always found willing to devote their time to its successful execution. It is thus that men engaged in laborious occupations, in which their time and talents are money, have devoted themselves, day after day, to labors enjoined by the Institution, without looking for any other reward than that of being useful. It is thus

that the pages of our Journal are supplied with materials, original and selected, (some requiring the labor of translation from foreign languages,) by the generous labors of collaborators, whose zeal is tried by the monthly repetition of its exercise. With all these resources at command, the Institute is still obliged to look to the benefit of this work to the mechanic, as a motive to support its expense, and to wait, in this as in some other enterprises, the time when a greater intelligence in our country at large, and increasing resources, will fully repay the pecuniary outlay annually made.

One branch of the labors of the members of the Franklin Institute has, I believe, no precedent in any similar institution—I mean that of original investigation and research. The Institution thus aids to advance as well as to diffuse knowledge. Of the experiments of the Committee on Water Power, one of the highest living authorities (Mr. Rennie) has spoken in terms of the highest praise. The results of the experiments on the explosion of steam boilers have contributed strongly to turn attention away from imaginary sources of danger, and to fix them upon real ones. The conclusions from some of the more refined and difficult experiments, are quoted in quarters which cannot be suspected of either local or national partiality. These various researches, together with those on the strength of materials, must ever remain a monument of the industry and zeal of the early members of the Franklin Institute. They furnish a claim to public favor and support that no similar institution can justly put forth.

From these extended schemes, in which the members of the Franklin Institute are only incidentally partakers with the public in the common good effected by their instrumentality, let us turn our attention to the special means of promoting the mechanic arts, through the intellectual cultivation of those who pursue them. In the infancy of science, every experiment led to a discovery, and the art offered a scarcely less fertile field than science to their cultivators. Now discoveries in science and improvement in art, are the result of well directed trains of observation, experiment and thought. To direct these, the arts call in the aid of theoretical science. Besides the general cultivation of mind to be derived from pursuing any branch of knowledge, in the sciences of mechanics and chemistry are to be found those principles which alone are safe guides to improvement. It will, perhaps, hardly be believed, but it is, nevertheless, true, that not ten years since there lived in our city an ingenious man, who wasted his time and substance, and the resources of his family, in a pursuit after the perpetual motion. How many such disastrous results are prevented from year to year, by the application of principles taught in the lecture room, may be inferred from the number which require the additional nipping action of the Committee on Science and the Arts. Besides, the lectures upon mechanics and chemistry, which constitute the frame-work of our system, the filling up of architecture, mineralogy, geology and mining, has been supplied by the voluntary contributions of members distinguished for their knowledge, and for their powers of communicating it; and even kindred branches of na-

tural history have been, from time to time, furnished from similar sources.

It has always been the liberal policy of the Franklin Institute, while retaining the control of the institution where, from its nature, the control should be retained—in the hands of mechanics—to call in the talents of other professions to their aid. While by the constitution, two-thirds of the Board of Managers must be manufacturers or mechanics, every citizen is free to become a member. No co-operation is spurned; and in return, knowledge, time, and talent, of various kinds, are at the disposal of the foster mother. This same liberal principle of action shows itself in the very moderate requital expected for all the privileges bestowed, by which membership in the Franklin Institute is placed within the means furnished by the deposit of one cent for each of the working days of the year. Exclusiveness is absent from each and every department of the Institute, and to a degree which, to those who believe such establishments are raised and must be used for the benefit of certain cliques, and the propagation of certain individual influences, is almost startling. What would be thought of raising a voluntary committee of the members of an institution, the annual contribution to which of three dollars makes a member, to consider important inventions and improvements in the arts. Such a thing, the advocates of cliques would say, must lead to confusion. A voluntary committee is wholly uncontrollable—and so it should be. Just such a committee—just so uncontrollable—has existed and flourished in the Franklin Institute for several years, every member being at liberty to join it who is willing to perform the labour required of him. I do not think I overrate the importance of this association of members, when I place it next to the lectures. The library and reading room are no doubt more extensively useful to the members; but the knowledge acquired from books and experience, which is called into action in such various ways, and on so many occasions, in the Committee on Science, and the opportunities for intellectual culture afforded by calm investigation, by cool, but earnest, discussion, and by the appeal to experiment, are so practically improving as to rank above all passive means of cultivation.

Besides the Lectures, the Library, and the Committee on Science, the Monthly Conversation Meetings serve as rallying points—as opportunities of giving instruction or of being instructed in the scientific or mechanical novelties of the day. In a large metropolis like London, it is always possible, during at least a part of the year, to obtain materials for even weekly meetings of this sort. At the Royal Institution of London, there is an informal lecture at least once a week, corresponding somewhat to our Conversation Meeting. If we could concentrate here the novelties which in our country find vent through various channels, we should be able to carry on these meetings with more spirit than is now done. In the meantime, they are often both agreeable and useful, and, doubtless, will be kept up with occasional intervals.

While thus providing for the improvement of its members, the Franklin Institute has not forgotten their families, their wives and

daughters, as well as their sons, wards, and apprentices. When the lectures of the Franklin Institute first commenced, ladies were not in the habit of attending lectures—in other words, custom most ungallantly excluded them from opportunities of intellectual amusement and advantage. The Institute has turned custom out of the doors, and taken the ladies within them.

A series of schools for youth at one time entered into the plan of the institution. Of these, the drawing school alone is still kept up with an efficiency and advantage which command patronage. I have very little doubt that had not public education taken the new position it now occupies in our city, these designs of the Institute would have been extended. The sovereign has now awaked to the advantages of supporting public schools by public means, although not yet fully prepared to push the principles upon which they are based to their utmost limit.

Among all these means of usefulness, there is no School of Commerce and the Arts like the Polytechnic Institution of Vienna, no School of Arts and Trades like the Berlin Institute, no School of Arts and Manufactures like the Paris Institution. The establishment of a School of Arts has been a favourite project with the Franklin Institute. but thus far has scarcely passed beyond a project; at one time on the point of receiving aid from the Commonwealth, at another almost put in operation by individual enterprize. This object requires means, and these we have not at our disposal. Will public opinion ever so far ripen as to furnish these means? This is an interesting inquiry. I have heard it remarked by more than one person conversant with the minutiæ of the institutions of Philadelphia, that all the enterprizes for the diffusion of knowledge are supported by a small portion of our population; and yet they are intended for the ultimate good of *all*, and should be supported by the *whole community*. There was no doubt a time when the idea of paying for the support of a fire department would have seemed preposterous, and now we quietly pay for insuring our houses, and then in addition, a portion of our taxes goes to furnish the means and appliances for extinguishing fires. What would we think now of supporting a fire department entirely by voluntary contributions? So publie opinion oscillates from one side to another. What is at one time impossible, at another is firmly established as the general usage. Where shall we draw the line between that which is to be supported by general assessment, and that by particular contribution? *Shall the principle be that, what is for the good of the whole, shall be supported by the whole?*

It has been long established that the poor must be instructed at the public expense. It is found *cheaper* to educate the masses than to pay for the fruits of ignorance. Besides which, christian charity cares for the souls as well as the bodies of men. But the scheme of public education, free to all, is, even now, and in our own country, very imperfectly understood. Indeed it may be doubted if the public are yet prepared fully to follow it to its consequences. We began, in this country, after the example of the old world, to endow institutions for higher education, universities and colleges. Then we found that this

was beginning to build the house at the top. We turned and established schools, common schools, and occasionally a high school. And now the foundation and superstructure have no connexion. Is not this all wrong?

If we want precedent for a different state of things from the old world, we can find it, and so be borne out by experience, as far as institutions trammelled by feudalism can be guides to us. The so-called University of France includes all public instruction within its organization; the highest and lowest are free; why not the middle? why not all?

But it may be said we agree that that which shall benefit all shall be supported by all. We agree that education shall be put upon a *truly republican* basis, that all the schools, from the lowest to the highest, shall be supported from the public purse, that a wider range shall be taken than now in education, and yet the whole shall be supported by the public. But you go further, you ask that institutions for the benefit of certain classes, by name merchants, manufacturers and mechanics, shall be supported or subsidized from the public purse. These classes certainly, in my view, make up no small or unimportant portion of our community. They are surely not so few in numbers, nor so insignificant in influence, that their interests may be overlooked.

But I would go beyond this, and include in one wide system all the institutions of every name for the promotion of knowledge. It is not necessary to weigh their relative usefulness. It would be easy to bring up an array which would include all classes of our community. The Mercantile Library has its objects, the Apprentices' Library others; the Philadelphia Library, the Athenæum, the Philosophical Society, the Academy of Natural Sciences, the Philadelphia Museum, the Athenian Institute, and many similar associations, each and all have their spheres of usefulness. Take them together, do not their objects include in their range the interests of every citizen of Philadelphia? Are they not intended for the benefit of classes which include all? Would not good done to all of them be done to the whole community? If not, let others occupy the vacant ground. Nor would the difficulty of adjusting claims be an insuperable one. For such it never has been in any country where such a plan has been in fact executed, and executed it has been in many, though not perhaps systematised. What, for example, is the support of the Polytechnic School of Vienna, and of its Conservatory, from the public purse, but part of such a scheme? and just such a part as the subsidizing of the Franklin Institute, under its present organization and management, would be. What the establishment of a Museum of Natural History and of Coins and Antiquities, but the support of the Academy of Natural Sciences and the Museum? What the support of a Royal Library but that of the Philadelphia Library? All of these, or nearly all, every where, are under different boards of administration. The scheme is not so Utopian as, at first sight, it might appear. Our schools, colleges, universities, institutes, museums, academies, associations, under whatever name, for the diffusion and advancement of

knowledge, constitute an assemblage of objects, embracing within its scope all classes and all interests. Let me commend to your thoughts the idea of forming *a system* from these various parts, not centralized, but like our own political union, each independent, while all are united, *a great system of public instruction, worthy the patronage and support of a free and enlightened people.*

If public opinion were once right in regard to it, the details of the plan would present no serious obstacles. I have just read that a munificent Englishman has left nearly half a million of dollars to two institutions connected with the University of Oxford. Perhaps liberal individuals among us may one day turn their attention to the beginning of some scheme of general secular instruction, required imperiously in aid of moral and religious culture, by the nature of our political institutions. Without intelligence, virtue is comparatively powerless; without virtue and intelligence, liberty degenerates into licentiousness, independence into brutality. Liberty and independence exist but in name. When virtue, liberty and independence fail, the commonwealth which has chosen them as her watchwords, and has emblazoned them with the emblems of agriculture, commerce and the arts upon her arms, will cease to have a being.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Babbitt's Soft Metal Boxes.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination the Manner of Lining Boxes for Axles, Gudgeons, &c. with Soft Metal, invented by Mr. Isaac Babbitt, of Boston, Massachusetts, REPORT,

That they refer to a former report, made in September, 1840, for a description of Mr. Babbitt's improvement. The favourable opinion expressed in that report has been confirmed by experience, and the superiority of the "anti-attrition metal" over common composition for bearings, fully established.

The advantages of this application of soft metal are, 1st, greatly increased durability of wearing surfaces; 2d, diminished friction; and 3d, reduced consumption of oil;—to which might be added the comparatively small cost of both time and money incident to relining bearings when worn out.

Mr. Babbitt exhibited to the Committee some very satisfactory certificates from companies and individuals who have used his boxes, attesting the saving of oil effected, and the greatly reduced wear of the machines, by the substitution of the anti-attrition for composition or gun metal.

The Committee believe this invention to be highly useful and important, and therefore they recommend the award of the Scott's Legacy Premium and Medal to the inventor.

By order of the Committee,

[illegible] 14*th*, 1842. WILLIAM HAMILTON, Actuary.

Report on Naglee's Railway for Short Curves.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a plan of a Railway for Short Curves, invented by Mr. Henry M. Naglee, Civil Engineer, of Philadelphia, Pennsylvania, REPORT,

That in Mr. Naglee's plan the inner curved rail is formed of a common flat bar or edge rail, without a groove, while the outer rail is composed of cast iron segments, with a surface three inches in width, inclined or bevelled inwards and downwards, and containing on the outer edge a flat rim, raised one inch above it, and two inches wide.

By this arrangement it appears that the wheels are kept within the rails by their flanches, as in ordinary roads. The inner wheels always move on their treads. As to the outer ones, since by the motion in the curve the wheels are thrown towards the outer rail, the flanches ride upon its bevelled surface, and may rise higher and higher upon it, until they are checked in this lateral motion by the rim.

A short curve of this kind has been laid at the Willow street depôt in Philadelphia, and has been seen by several members of the Committee in successful operation. Indeed it contains the essential condition of success—namely, that the car is constrained, by the mechanical bonds with which it is confined, to pursue the path marked out for it. All the other plans in use for turning short curves (viz: Stimpson's, Malcom's, and the common track,) have this indispensable character, and with it all succeed, and seem to operate *almost equally well.*

Great importance, indeed, has been attached to the device of virtually increasing the diameters of the outer wheels, by making them rest on their flanches, and thus bringing into action what is called the "conical principle." And it is, certainly, true that if a single pair of wheels, of different diameters, firmly attached to an axle, were to roll freely over a plane, they would move in a circular arc, the centre of which would be the point in which the line of the axle produced would meet the plane. But in every practical case, there are at least two pairs of wheels, attached to axles parallel to each other; and the curves in which they would severally move, if alone, having different centres, cannot possibly be described at the same time. Hence it is evident that when wheels of different diameters are attached to parallel axes, they cannot move at all, either in straight or curved lines, without some of them sliding. There may, certainly, be less sliding where curves are described, with the outer wheels of greater diameter; but if any advantage be thus gained, it does not seem to be of much practical value.

The most usual position for railways of short curves is in the public streets, where they are used for turning corners, or for leading into depôts. In such situations, it is a matter of great importance that the curved ways should be so constructed as not to interfere with the safe passage of common carriages and horses. One of the conditions re-

quired for this object is, that the rail be placed as nearly as possible upon a level with the street, and in this case, when the wheel moves on its tread, there must be a grooved depression along the inside of the rail, to admit the flanch. In the plan under consideration, no such groove is admitted, and hence even the inner rail must be sufficiently elevated to keep the flanch above the pavement of the street. As to the outer rail, its elevation will be still greater, in consequence of its bevelled surface and its raised rim.

The Committee do not feel called upon to consider the much agitated question of the comparative merit and originality of the different plans devised for turning short curves on railroads; but, having presented whatbelieve they to be a candid and correct view of the construction and action of that submitted to them, they here close their report. By order of the Committee,

August 11*th*, 1842. WILLIAM HAMILTON, Actuary.

Report on Hill's Occultator.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the model of an Instrument for Calculating Occultations, invented by Mr. Thomas Hill, of Cambridge, Massachusetts, REPORT,

That they have examined the model of Mr. Thomas Hill's Occultator, together with his demonstration of the principles on which it is constructed and used; both of which are entirely satisfactory, and show that by the use of the Occultator, without a table of logarithms, and with the elements given in the Nautical Almanac, or still more convenient, with those of Downes' United States Almanac, the time of beginning and end of an occultation or eclipse may be found with sufficient accuracy for practical purposes. The instrument must be highly useful to those who are desirous of observing occultations, and are not familiar with the use of logarithms and trigonometric formulæ. They would merely remark that instead of the moon's true hour angle and declination, it would be more precise to use those of the star in case of occultations. The model and process are founded on true geometrical principles, and furnish, in the opinion of the Committee, a new application of those principles, and an original invention of an instrument called the Occultator. They respectfully recommend to the Committee on Science and the Arts to advise the bestowment of one of the Scott's medals on its highly meritorious inventor.

By order of the Committee,

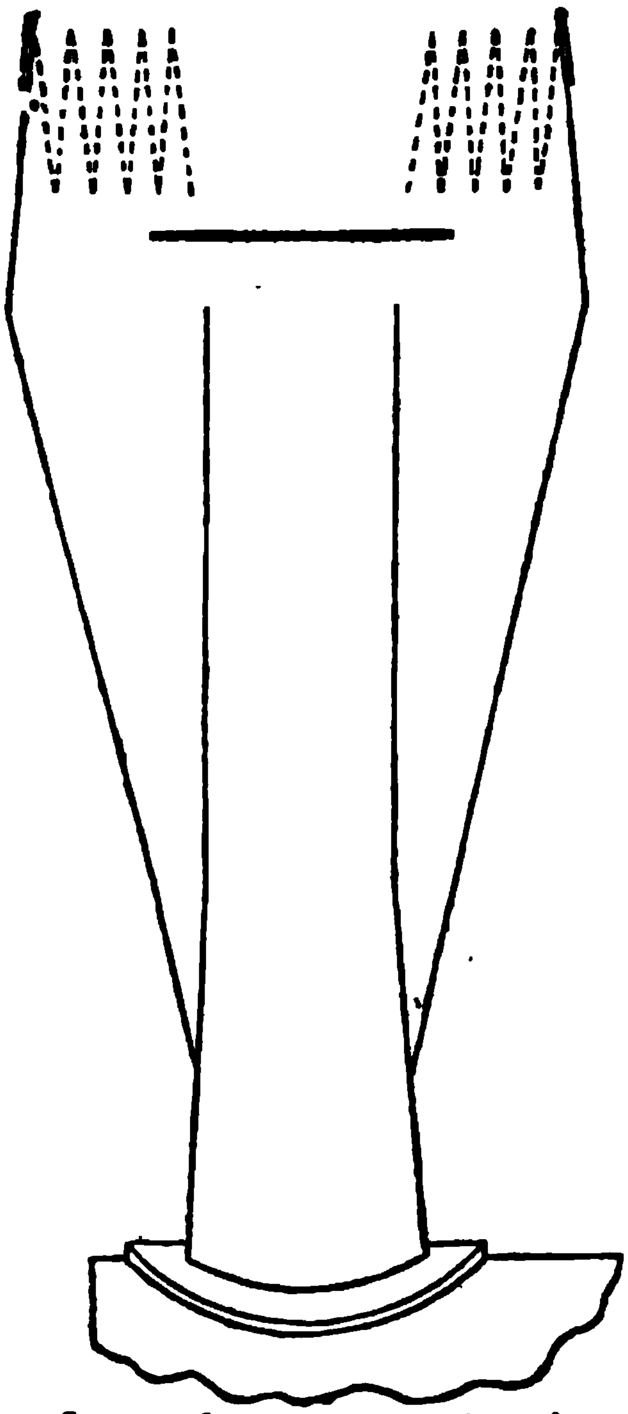
October 13*th*, 1842. WILLIAM HAMILTON, Actuary.

Report on French's Spark Arrester.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Spark Arrester for the Chimneys of Locomotive Engines, invented by Mr. Richard French, of Philadelphia, Pennsylvania, REPORT,

That this contrivance for preventing the emission of sparks from

the chimnies of locomotive engines, consists of several broad hoops of sheet iron, in the form of conical frustums, placed so as to encircle each other, and riveted together at the edges, so as to form a series of concentric annular spaces, and to afford a large surface of sheet



iron within a moderate circumference. This sheet iron is perforated with a great number of small holes, about one-sixteenth of an inch in diameter, punched inwards to prevent their clogging with soot, and affording in the aggregate an area of opening several times greater than that of the chimney, which is enclosed by the sheet iron case that carries the spark arrester.

If the chimney of the engine be one foot in diameter, the surrounding case, at its widest part on a level with the top of the chimney, may be three feet; and, with nine concentric perforated hoops, each of ten inches or a foot in breadth or height, an area of sheet iron for perforation may be obtained equal to fifty or sixty square feet, which is an ample allowance. A central space, fifteen inches in diameter, directly over the top of the chimney, is left open, for a standing draught, and permits the smoke to escape when the engine is standing. Five inches above the top of the chimney, and three inches below the bottom of the perforated hoops, a circular plate of iron, nineteen inches in diameter, is placed horizontally, which prevents the sparks, when driven upwards by the blast, from escaping through the open space in the centre of the top of the case—which arrangements will more fully appear by inspecting the above diagram. The circular chamber between the chimney and the external case, forms a receptacle for containing the sparks; out of which they pass through an opening made for the purpose. The flat plate above the top of the chimney, prevents the direct action of the blast against the perforated iron, and reflects a large part of the sparks and cinders, so that they fall into the receptacle by rebounding from the plate.

The best test of the utility and efficiency of a spark arrester, is long-continued experience. Mr. French's contrivance has been in daily use upon the Philadelphia, Germantown, and Norristown Railroad, for nearly a year, on three of the locomotives, and has given great satisfaction in arresting the sparks without stopping the draught, being found much superior to several others that have been tried, the fuel used being pine wood. When the engine is running with the fire box full, no sparks are seen; when fuel is added, a few may escape, and when near the end of a trip, a few brands only remain on the

grate bars, the most sparks find their way out, but they are so small as not to cause danger. Although more or less dust escapes with the smoke, there is nothing which burns the clothes of either the conductors or passengers.

The present spark arresters have five hoops, with about forty feet of surface, and holes one-sixteenth of an inch in diameter. It is thought that less dust will escape if the surface is increased and the size of the holes diminished.

Those who have traveled much on many of our American railroads where pine wood is burned, are aware of the great annoyance of the sparks, particularly in warm weather, when the windows of the cars are open; and on some lines, the engines are followed at night by a fiery trail of great length, which, however beautiful an object to the spectators at a distance, is anything but agreeable to those within its reach. Mr. French's contrivance is one of the best and most durable devised for abating this nuisance; it is not expensive to construct, and is well worthy of the consideration of gentlemen interested in railroad transportation.

By order of the Committee,

September 8th, 1842. WILLIAM HAMILTON, Actuary.

Mechanics' Register.

SPECIFICATIONS OF ENGLISH PATENTS.

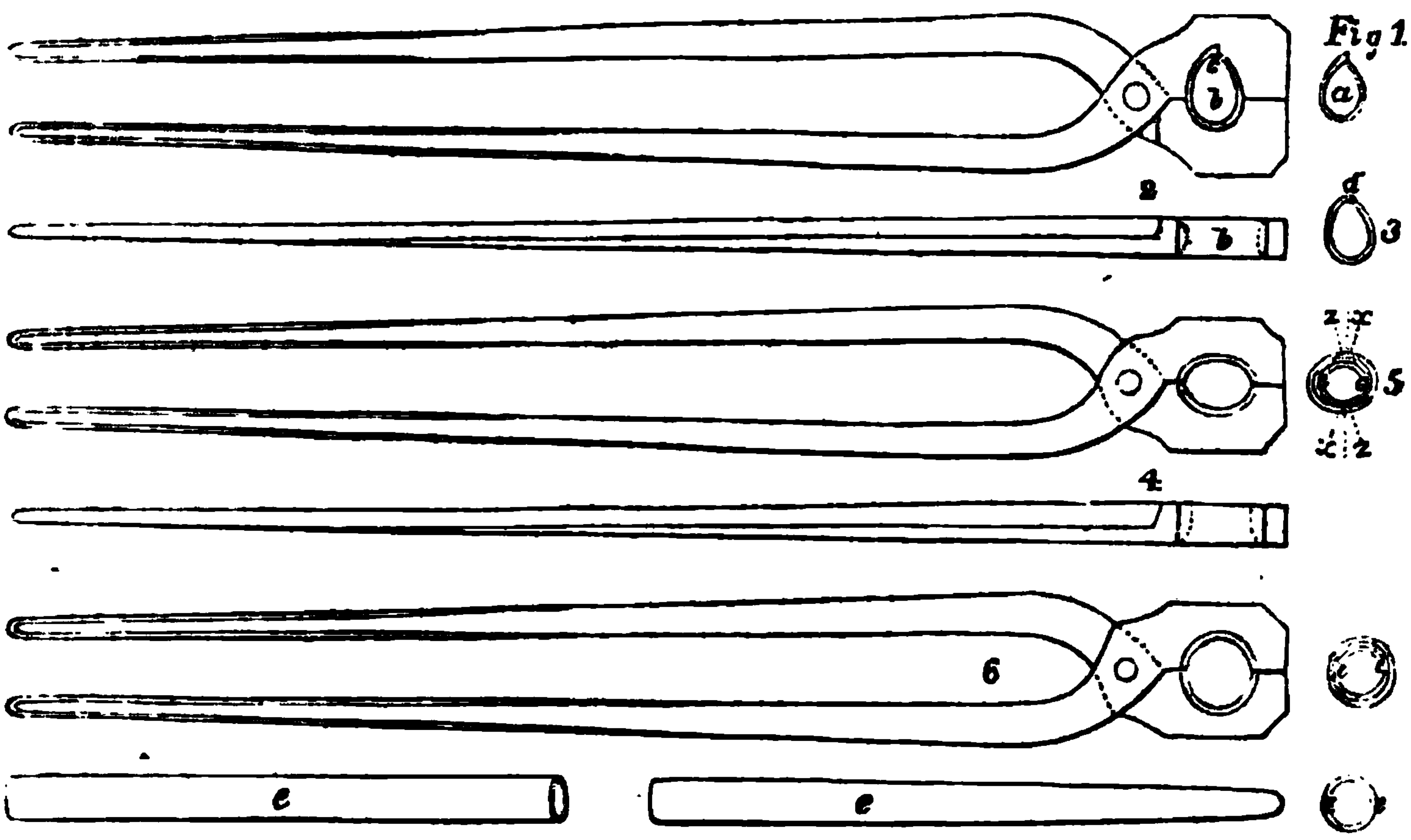
Specification of the Patent granted to THOMAS HENRY RUSSELL, *of the County of Stafford, Iron Tube Manufacturer, and* CORNELIUS WHITEHOUSE, *of the same place, for Improvements in the Manufacture of Welded Iron Tubes.*—Sealed March 7, 1842.

To all to whom these presents shall come, &c. &c.—Our invention relates to improvements in welding the joints, or seams, of wrought iron tubes, when made by external pressure, by passing the iron in a welding state between dies, or through holes; and the improvements consist of a means of employing internal support, and in such manner that the instrument which gives the internal support being introduced into a partly formed tube, is caused to pass with the tube through the dies, or holes, used, by which the requisite external pressure is obtained; and when the weld is completed, the instrument used for giving internal support, owing to its being of small diameter when compared with the diameter of the finished tube, may readily be withdrawn by causing the welded tube to be pressed into a cylindrical form. And in order that our invention may be most fully understood, and readily carried into effect, we will proceed to describe the accompanying drawings.

Description of the Drawings.

a, fig. 1, represents an end view of a skelp of iron turned into the shape shown. This skelp being heated to a light or moderate weld-

ing heat, is drawn through the tongs, *b*, fig. 2; these tongs have a bell, or enlarged mouth opening, and the upper part at *c*, is so sunk as to cause the turned skelp of iron to assume the shape shown at fig. 3—



one edge of the skelp touching the inner surface at the other edge of the skelp, which is caused to overlap, as is clearly shown at *d*, and a partial weld is thus effected. A cylindrical bar, or rod, of iron, *e*, is then introduced into the interior of the skelp, or partly formed tube, and the skelp, or partly formed tube, is to be heated to a welding heat, and then, by means of a draw-bench, the tube, with the instrument, *e*, within it, is drawn through the hole in the dies, or tongs, fig. 4, the pressure being in the direction of the dotted line, *y*, *y*, by which the metal of the joint, or seam, will be pressed together, and the instrument, *e*, which will not have become very highly heated, will be securely held in the tube. The tube being kept at a welding heat, is turned round slightly, and again drawn through the hole of the die, or tongs, fig. 4. In this instance, the principal pressure will, however, be in the direction of the dotted lines, *z*, *z*, in fig. 5, and the seam, or joint, will be pressed on a little on one side of the central line thereof. Then the tube is again drawn through a hole in the tongs, or dies, fig. 4, which are caused to give the principal pressure a little on the other side of the central line of the seam, or joint, as is indicated by the dotted lines, *x*, *x*, fig. 5, the tube being turned in such manner that the tongs may grasp it in the positions indicated by the dotted lines, *x*, *x*, and *z*, *z*, by which means a very effective lap-joint and weld will be obtained to the tube. We prefer to use three pair of tongs, fig. 4, for this purpose, so that the tongs used for each time of drawing may be immediately put into water, and any scale which may adhere removed. The tube is then drawn through the hole in the die, or tongs, fig. 6, which causes the tube to assume a cylindrical shape; and, owing to the smaller diameter of the rod, or bar, *e*, it will be immediately released, and may readily be withdrawn from the welded tube.

We would remark, that we prefer the pressing dies used to be in the form of tongs, owing to the cheapness of their construction and the facility they offer for being cleansed, by dipping them in water after each time of use, when the scale (if any adhere) may be readily removed; such construction of dies also allowing the workman to change from one size of tube to another more readily. At the same time, we do not confine ourselves to the use of dies in the form of tongs, as grooved rollers or other dies—such, for instance, as are described in the specification of Cornelius Whitehouse, of the 26th day of July, 1825—may be used for performing the welding process when the internal support, *e*, has been introduced; but we consider hand dies in the shape of tongs to be the best. The workman in using the tongs rests them against a suitable stop formed on the draw-bench, and he causes the parts of the die to close as the tube begins to pass through the die.

We would also remark, that the dies, and the manner of using them, shown and described, are very similar to those now used in the making of welded iron tubes, according to the specification of the former patent granted to the said Cornelius Whitehouse, they differing only in the shape of the bell mouth given to them respectively.

And we would wish it to be understood, that we do not claim the using of such dies when uncombined with the use of an internal support, *e*, similar to that shown in the drawing, nor do we claim the use of an internal support when using external pressure in welding iron tubes, unless the instrument for giving internal support be such as to pass with the tube through the holes, or dies, used, and offer internal support from end to end of the seam, or joint, of the tube, which is to be welded; the bar, or rod, *e*, being of such diameter, in respect to the tube, that on shaping the tube, the bar, or rod, *e*, shall be released, as before mentioned, so as to be readily withdrawn, owing to the smallness of the diameter when compared with the tube welded thereon. It will, therefore, be seen, that the tube does not move or slide on the bar, or rod, *e*, when the process of welding is being performed. In order to obtain lightness of the instrument, *e*, used for giving internal support, we prefer that it should be hollow, and we have used strong welded iron tubes for this purpose. The instrument, *e*, is longer than the tube welded thereon, and protrudes a short distance through at each end; and care is to be observed in raising the tube to a welding heat, that the ends of the partly-formed tube, and also of the instrument, *e*, are to be kept out of the strong action of the fire, in order to prevent those parts being raised to a welding heat. For this object we have a hole at the back of the furnace for the end of the instrument, *e*, to protrude through, and for the end of the tube to enter, so that the heat is applied to the tube only, and not quite up to the end thereof; and when the fire, or furnace, is not sufficiently long to heat the length of tube desired at one heat, then we first make the tube in the manner described above, for a part of the length of the skelp, and when the same has been cooled, we insert the instrument, *e*, and finish the other end of the skelp by raising it to a welding heat, and drawing it in like manner to the first end of

the skelp. The tube thus made is subsequently raised to a bright red heat, or a moderate welding heat, and is drawn through a pair of dies rather less than those at fig. 6, which slightly reduces the diameter of the tube, and brings it to the size desired. The tube is then to be straightened as heretofore, and the ends cut off, when the tube will be complete. We prefer that the instrument, *e*, should simply be straightened, and not cooled down between each succeeding tube in which it is used, it being desirable to keep the instrument, *e*, hot. We would observe, that this invention is particularly applicable when thin welded iron tubes are desired, such as for the tubular flues of locomotive, or similar steam-boilers, for which purpose we are now using iron of No. 14, of the wire gauge, and we are now making such tubes from one and a half to two inches diameter; but these dimensions may be varied. The drawings show the size of the bar, or rod, used, when making tubes of two inch internal diameter; and it will be evident that the diameter of the bar, or rod, *e*, will be varied according to the size to be made.

Having thus described the nature of our invention, we would wish it to be understood that we do not confine ourselves to the various details shown and described, provided the peculiar mode of applying internal support, combined with the welding of wrought iron tubes by external pressure, be retained, whereby a bar, or rod, *e*, though of much smaller diameter than the tube welded thereon, is caused to give efficient support to the seam, or joint, of a tube, when being welded by external pressure, and whereby the bar, or rod, *e*, is caused to pass under pressure with the tube, and be released after the weld is obtained by the subsequent shaping of the tube, as above described.

THOMAS HENRY RUSSELL,
CORNELIUS WHITEHOUSE.

Lond. Repertory.

Specification of a Patent granted to JOHN CARR, *of North Shields, and* AARON RYLES, *of the same place, for an Improved Mode of Operating in certain Processes for Ornamenting Glass.*—Sealed May 9, 1842.

The "improved mode" here patented is stated to consist in the application to glass "of the process usually called by glass-stainers *printing*, with materials which have not heretofore been used in that way, and under circumstances which give great facility for, and make great improvements in, ornamenting glass."

First, as regards the *staining* of glass, the improved mode of operating is stated to be as follows:—"Instead of mixing the staining materials now in use for that operation, when levigated finely and dried, with oil of turpentine, or other volatile oils, or water, as usual, we mix them with boiled linseed, or other oil, such as is now used to mix with enamel colors, when printed on glass; and instead of floating the staining materials over the glass in a liquid state, as is now practised, we print them on, or transfer them as impressions from,

metal plates, in the manner now adopted in the operation of printing enamel colors, and proceed, after the material transferred has been well dried, to fire it for the color required, in the usual way. When we operate with the same staining materials, so mixed with oil as aforesaid, on what is called pot metal, or on pieces of glass which are what is called 'flashed,' opaque and transparent shades are produced, leaving the surface of the glass quite smooth, and not raised in those parts, as in the common mode of applying body color for the purpose of shading."

Second, as regards the operation of what is called *stopping-out*, the patentees give the following directions:—"We also mix the materials used for that purpose into a composition with boiled oil, as aforesaid, and transfer printed impressions on to the glass with it, as before explained, covering such parts as are not to be acted upon, and can then float over the whole surface, including the parts so stopped out, with liquid staining composition, and fire it as usual, to produce the stain; after which, the glass being cleaned, the pattern so printed on it in stopping-out materials, is exhibited in the original color of the glass, and quite distinct from the stained ground; or a printed impression being transferred to the glass in stopping-out materials, as aforesaid, the remainder of the ground may be obscured, as it is called, in the usual manner—thus producing transparent patterns on obscured grounds."

Third, as regards the operation of what is called *obscuring* glass, the patentees say:—"We also mix the materials which are used to produce this effect with boiled oil, and transfer impressions from engraved metal plates on to the glass; this produces obscured patterns on transparent grounds. Now, whereas, it is evident that in all processes for ornamenting glass, by staining, stopping-out, or obscuring, the means we have discovered of mixing the staining, the stopping-out, and the obscuring materials, with boiled linseed oil, so as to enable us to print with the composition from copper, or other engraved metal plates, gives us the power of greatly improving, perfecting, diversifying, and multiplying, the combinations of patterns, grounds, and devices—while it does not deprive us of the aid of enamel colors to add to that diversity as usual."

The claim is to the use in those processes for ornamenting glass, where staining, stopping-out, or obscuring materials, are employed: of 1st, the mode before described of transferring the said materials in the form of impressions from engraved plates of metal on to the glass, in the same manner as now practised in printing in enamel on glass, namely, by mixing the said materials with boiled linseed or other oil, and 2nd, of the application of the staining material, so mixed with oil, to pot metal or to flashed glass generally. The patentees add, that by "the said improved mode of operating with the said materials, we are enabled greatly to improve, perfect, render more exact, diversify, and multiply the combinations of patterns, grounds, and devices for ornamenting such glass as aforesaid, and to produce the same, so ornamented, at a cheaper rate."

Mech. Mag.

Specification of the Patent granted to GOLDSWORTHY GURNEY, *Esq., Bude, Cornwall, for certain Improvements in the Production and Diffusion of Light.*

My invention relates, first, to a mode of improving the illuminating powers of coal gas, by subjecting it to the chemical action of certain substances hereafter mentioned, in its passage from the gas main to the burners.

Secondly, my invention relates to a mode of applying reflectors, whereby the light produced may be more beneficially diffused, and, in conjunction with the use of such reflectors, the application of certain glass refractors of light.

Thirdly, my invention relates to the application of gas-burners made of concentric rings of tubing, perforated on the upper surfaces, for the passage of gas, when such burners are used in combination with glass chimnies, for lighting apartments and other places; and,

Fourthly, my invention relates to a mode of applying conical glass chimnies to lamps, in order to keep the flames thereof quiet, and most beneficially to supply them with air. And in order that my invention may be most fully understood, and readily carried into effect, I will proceed to describe the means pursued by me in carrying out my invention. It is well known that the use of gas as a means of lighting rooms and internal parts of buildings, is comparatively little resorted to, owing to offensive smell, its great heat, and other objections arising from other causes. Now the first part of my invention has for its object the submitting of gas, in its passage from the supply-main to the burner, or burners, to the chemical action of certain matters hereafter mentioned, whereby gas will not only be greatly improved in its illuminative powers, but, at the same time, the heat of the burning gas will be reduced, and its use in rooms and apartments rendered inoffensive. The materials I employ for this purpose are muriate of zinc, sub-acetate of lead, chloride of baryta, and sulphate of manganese; and these materials are to be used either dry or slightly moistened, in similar vessels to what are used in purifying gas by what is called the dry-lime process, by which the gas in its passage through the vessel is caused to pass in contact with as extensive a surface of the materials used as possible. And the object of the invention is to give to the consumer the opportunity of heating the gas to be consumed by him according to my invention, after it has passed through the ordinary processes of the gas-works; and for this purpose I apply a vessel of the description above mentioned to the gas supply-pipe, by which the gas in passing from the gas-main of the gas company, may pass amongst, and be chemically acted on by, the matters above mentioned, or some of them, before coming to the burner or burners. The most important of the above-mentioned materials is the muriate of zinc, and the use of that material alone will be found of great benefit; but I prefer to use therewith a mixture of the other matters above mentioned, and the mixture I have found best for the purpose is as follows:—5 parts muriate of zinc; 2 parts sub-acetate of

lead; 2 parts chloride of baryta; 4 parts sulphate of manganese. And I have found that about 6 lbs. of the mixture, placed in a vessel of the description above mentioned, (and which is well known,) and of about the following dimensions: 2 feet 6 inches long, 1 foot 6 inches wide, and 1 foot deep, to a supply-pipe of three-quarters of an inch internal diameter, and in proportion for larger or less supply-pipes, fully answers the purpose; and when in constant use, the materials above mentioned should be changed about every three or four weeks.

I would remark, that although I prefer the above described means of applying the above-mentioned materials, I do not confine myself thereto, so long as the means resorted to are such as to bring the gas in contact with muriate of zinc, with or without other suitable matters, in the passage of the gas from the gas-main to the burner, or burners.

GOLDSWORTHY GURNEY.
Mining Jour.

Specification of a Patent granted to ROBERT STIRLING NEWALL, *of the County of Durham, for Improvements in the Manufacture of Flat Bands.*—Enrolled May 16, 1842.

The improvements of the present patentee consist in manufacturing the flat bands used in mining operations, and for driving machinery, *exclusively of iron or other metals.* Three processes are described. According to the *first*, a flat band is manufactured, by subjecting a piece of iron, or other metal, of good quality—preferring that known as the best charcoal iron, manufactured in the usual way by rolling—to a process of drawing through rectangular orifices, or dies of hardened steel, in the same manner as in the ordinary and well known operations of tube or wire drawing. The patentee considers it to be of importance that the piece of metal to be operated upon should be drawn through the die, in a straight line at right angles to its edge; and as it is difficult to roll iron beyond a certain length, he suggests that it may be found convenient to draw it in a hot state through dies. Again, as in the process of drawing, the metal becomes hardened, the patentee directs that (if necessary) it should be annealed, by heating it in a furnace; and after the oxide has been removed from it, by means of diluted sulphuric acid, that the process of drawing should be repeated when cold. When a band of considerable length is required, it may be necessary to unite two or more bands together. Various methods of effecting this junction are pointed out and illustrated by drawings. Scarfing the ends, and riveting, are considered to be much preferable to welding or brazing, as the operation of hammering in welding gives a brittleness to the metal, which no subsequent process of annealing can remove, so as to give the hammered part the same strength which it had before; and in brazing, the union of the two metals is not such as can be trusted to. These bands, when of iron, may vary in thickness from one-twentieth to one-fourth of an inch, and in breadth according to the strength required. Flat bands, manufactured in the way described, are stated to possess greater

strength and durability than those of hemp, or any similar material of the same weight; and if extreme lightness, with the greatest degree of strength, be required, steel may be used instead of iron. In some situations, where the iron becomes rapidly corroded, the bands may be made of copper, instead of iron or steel.

The patentee's *second* improvement consists in manufacturing flat bands of a combination of narrow bands, or strips, of iron, or other metal; which bands, for some purposes, particularly in deep mines, possess advantages over the flat bands before described, on account of the greater security against accident or sudden breaking which such a combination presents. The strips of metal are arranged side by side, and fastened to cross pieces. Metal drawn through dies, as before described, is used, or metal rolled in strips, taking care to select such as are straight and free from flaws, and, if necessary, to cut their edges true and parallel, which may be done by circular shears. The pieces of which the flat band is to be composed, are laid side by side, and kept in a state of equal tension by weights acting over pulleys, while the cross pieces are riveted on, and jointed at the end by a butt, or by an overlap joint. The cross pieces may be from eighteen inches to five feet apart; the breadth and thickness of the component pieces of the band varying according to circumstances.

The *third* improvement consists in forming a flat band by weaving narrow strips, or wires, of metal, in a loom, the strips, or wires, which constitute the warp, being wound on separate bobbins, and kept at a uniform tension during the operation of weaving. It is stated to be, in most cases, advisable to have the wire used as the weft of smaller size than that used as the warp. Mech. Mag.

The Hot-blast Patent.

This patent expired on the 11th of September for England, and on the 1st of October for Scotland, and has proved one out of the few which are eminently successful to the inventor. Besides being of great national benefit, it has realized a sum of not less than £150,000 to the patentees, and has placed John Beaumont Neilson high in the ranks of the benefactors of, not his country alone, but of mankind—iron being the most useful of the metals, and its cheap production of immense importance in arts and manufactures, on which the conveniencies and comforts of life depend. In no small degree has the economising that valuable mineral, coal, been promoted by this discovery; where formerly nine tons were required in Scotland to make one ton of pig-iron, it is now done by two and a half tons, or less, and inferior descriptions of both coal and ore may be used, which before could not be applied; and from this cause a prejudice has arisen against iron made with hot air, which should rather be attributed to those ores and coals which produce weak iron, than to heated air, which, with proper materials, makes as strong, and even stronger, iron than cold air; even the most prejudiced admit this fact in the case of iron made with anthracite coal. The experiments of Messrs.

Hodgkinson and Fairbairn, made under the direction of the British Association, show this fact in iron from the clay ironstones, and also the red ores. It would only be common justice that some national testimonial should be awarded to Mr. Neilson, and it is hoped that some influential party will take the lead in perpetuating the name of a benefactor who may be classed with Arkwright and Watt in the mighty effects of his discovery. Mining Jour.

Practical & Theoretical Mechanics & Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Kalsomine Paint.

In answer to the many applications as to the "material" and "merits" of the Patent Kalsomine Paint, now working so extensively into notice, I avail myself of information derived from practical men in this city, together with the result of my own personal observations, to give some few ideas on the subject.

I find, by test, that the ingredients of which this paint is composed, are, in the first place, removable by water, after their application, but become permanently fixed by a subsequent operation—an advantage to the painter, as thereby he has an entire command over the material he is using; he can apply as much as is required to a wall, or other surface; if necessary, can remove a part, and when the whole is covered to his satisfaction, he renders it insoluble by the application of a "fixing solution," which, combining with the paint applied, fixes it on the wall, or surface, painted. This is an advantage hitherto unattempted in any system of house-painting, places the art of laying and blending colors entirely in the painter's power, and enables him to use pigments which are more solid than those now in use, but which cannot be mixed in oil. From the nature of the kalsomine material, it must offer every resistance to the action of atmospheric agents, a property of the utmost weight. We all know the uncertainty of many of the more delicate tints used for interior house-painting, either in oil or spirit, bearing the action of the light, and the atmosphere, even for a short time, either flying off or turning darker. Not so, however, with the kalsomine colors. These destructive agents do not appear to affect them, judging from specimens of painting executed some time since. In support of what I say, the uniform and fresh appearance of the delicately tinted pearl panels at the Depôt in Broadway, is a case in point; these, to my knowledge, have been painted eighteen months, and as yet no visible change has taken place. An eminent lecturer on chemistry, in this city, agrees with me on this head; on chemical principles he says that kalsomine paint is indestructible.

Kalsomine is made of various tints. From samples of these colors now before me, I find that No. 1 is a pure white pigment, to be used either alone or as a "base," after the manner of white lead, in oil paints; the numbers following, from 2 to 12, are colors for painting the white, all being of exceeding brightness, and withal soft and agreeable to the eye. These are mixed for use according to very simple instructions, given to purchasers by the patentee.

In reference to the material used in the finishing process, by which the paint is rendered fixed, and, consequently, capable of being washed; this is done by the application of what the inventors call a "fixing solution." By analysis, I am unable to my satisfaction to detect *all* the component parts of this solution, but since the material and peculiar method of working kalsomine, is protected by patent, the publication of what I know on the subject would answer no useful end. I can only say that it answers the purpose intended.

The merits of kalsomine painting, compared relatively with the ordinary mode of interior painting, in lead, oil, quips, &c., I should say from my knowledge of both, as far as I can judge, may be reduced to this—from resistance of kalsomic paint to atmospheric agents, the color neither flies off nor becomes darker, which cannot be said in favor of paint in oil or flatting. Kalsomine paint is also more luminous and agreeable to the eye; all the surfaces I have seen painted with it are, certainly, brighter, and at the same time mellower, than anything in "flatting" or otherwise. It has a warmth and glow peculiar to itself, diffusing and softening light, and materially lighting up rooms comparatively dark. Being free from smell, from its nature incapable of injurious effect upon health, and drying in one-sixth of the time of ordinary paint, it is peculiarly advantageous and available to families to whom it would be inconvenient to leave their dwellings while painting. I have myself slept in a room painted during the day, and should not have remarked that it was fresh but for the glow I have already spoken of.

In well kept rooms I believe that kalsomine paint will stand in the ratio of three to one, compared with the old system, in permanence of color. Time will attest what I say, or, with others, I am sadly in error in my judgment.

If I am asked whether kalsomine painting is cheaper than that done by the old method, I answer—the first cost is below that of the old method. Painters in this city, whose work they will warrant to answer the end promised—to be guaranteed by the patentee—offer to paint for me, on plain surfaces, for fifteen per cent. less than they would do the same in oil or flatting. It is, therefore, cheaper, and

even at the same price, it is cheaper, if what I have already asserted is correct, being, from its nature, more permanent.

Many other points might be adduced in favor of kalsomine paint, which are obvious from what I have already said, but, per contra, it has its disadvantages when compared with white lead in oil. From the exceeding brightness and delicacy of its tints, it is soiled more readily, and, therefore, for many parts of interior house-painting, it is exceptionable. The idea of introducing kalsomine paint to supersede entirely the use of white lead in oil for house-painting, is ridiculous, if such was ever the intention of the patentees. Kalsomine paint has been washed in my presence, and in some cases I doubt not that washing carefully improves it; but whether, if introduced into the culinary department and the like places, it would stand the operations of careless servants, without being more impaired than the white lead in oil, I leave for others to prove. I should not recommend it for such work.

The foregoing remarks, the result of actual experiment, enquiry, and observation, are offered, believing that they will be acceptable to many individuals, if they have found the same difficulty with myself in obtaining correct information.

In conclusion, if we can get our houses painted cheaper, to look as well and to last as long, to be applied quicker, and without the disagreeable effluvia attending the use of white lead, oil, and turpentine, then is kalsomine paint preferable, and a benefit to the public. The material may be depended on, and all that is to be feared is its injudicious application. W.

New York, October, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

To the Committee on Publication:

Gentlemen:—I am uncertain whether you may not deem the following remarks out of place in the Journal, as they may be supposed more nearly related to the subject of natural history than to those to which your publication is more immediately devoted.

Very respectfully,

Thos. Ewbank.

New York, September 20, 1842.

The Ingenuity of Spiders.

The mechanical resources of the lower animals have often excited admiration, and though no comprehensive and systematic series of observations have yet been made upon them, the time is, I believe,

not distant when the task will be undertaken—perhaps within the next century. But whenever and by whomsoever accomplished, the mechanism of animals will then form the subject of one of the most interesting and *useful* volumes in the archives of man.

Among insects, spiders have repeatedly been observed to modify and change their contrivances for ensnaring their prey. Those that live in fields and gardens often fabricate their webs or nets vertically. This sometimes occurs in locations where there is no object sufficiently near to which the lower edge or extremity of the web can properly be braced; and unless this be done, light puffs or breezes of wind are apt to blow it into an entangled mass. Instead of being spread out, like the sail of a ship, to the wind, it would become clewed over the upper line, or edge, like a sail when furled up. Now how would a human engineer act under similar circumstances? But ere the reader begins to reflect, he should bear in mind that it would not do to brace the web by running rigging from it to some *fixed* or immovable object below—by no means;—for were this done, it could not yield to impulses of wind; the rigging would be snapped by the first blast, and the whole structure probably destroyed.

Whatever contrivances human sagacity might suggest, they could hardly excel those which these despised engineers sometimes adopt. Having formed a web, under circumstances similar to those to which we have referred, a spider has been known to descend from it to the ground by means of a thread spun for the purpose, and after selecting a minute pebble, or piece of stone, has coiled the end of the thread round it. Having done this, the ingenious artist ascended, and fixing himself on the lower part of the web, hoisted up the pebble until it swung several inches clear of the ground. The cord to which the weight was suspended was then secured by additional ones, running from it to different parts of the web, which thus acquired the requisite tension, and was allowed, at the same time, to yield to sudden puffs of wind without danger of being rent asunder.

A similar instance came under my notice a few days ago. A large spider had constructed his web, in nearly a vertical position, about six feet from the ground, in a corner of my yard. The upper edge was formed by a strong thread, secured at one end to a vine leaf, and the other to a clothes line. One part of the lower edge was attached to a Persian sun-flower, and another to a trellis fence, four or five feet distant. Between these there was no object nearer than the ground, to which an additional brace line could be carried; but two threads, a foot asunder, descended from this part of the web, and, eight or ten inches below it, were united at a point. From this point, a single line, four or five inches long, was suspended, and to its lower

extremity was the weight, a *living one*, viz. a worm, three inches long, and one-eighth of an inch thick. The cord was fastened around the middle of the victim's body, and as no object was within reach, all its writhings and efforts to escape were fruitless. Its weight answered the same purpose as a piece of inanimate matter, while its sufferings seemed not in the least to disturb the unconcerned murderer, who lay waiting for his prey above.

Whether the owner of the web found it a more easy task to capture this unlucky worm and raise it, than to elevate a stone of the same weight, may be a question. Perhaps in seeking for the latter, the former fell in his way, and was seized, as the first suitable object that came to hand—like the human tyrant, (Domitian) who, to show his skill in archery, planted his arrows in the heads of men or cattle, in the absence of other targets. It may be, however, that a piece of stone, earth or wood, of a suitable weight, was not in the vicinity of the web.

To observe the effect of this weight, I separated, with a pair of scissors, the thread by which it was suspended, and instantly the web shrunk to half its previous dimensions—the lower part became loose, and with the slightest current kept shaking like a sail shivering in the wind. A fresh weight was not supplied by the next morning; but instead of it, two long brace lines extended from the lower part of the web to two vine tendrils, a considerable distance off. These I cut away, to see what device would be next adopted, but on going to examine it the following day, I found the clothes line removed, and with it all relics of the insect's labours had disappeared.

Report on the Bude Light. By ANDREW URE, *M. D., F. R. S.*

From the report of a committee of the House of Commons, it appears that this light is so called from *Bude*, in *Cornwall*, the residence of its inventor, Mr. Gurney—a name bestowed upon it at the Trinity House, to distinguish it from the ignited light which he first described in his work on chemistry, in the year 1823.

The Bude light originally consisted of an oil argand flame, having a stream of oxygen thrown up over its internal surface, which produced a very vivid illumination. It was found, however, after having been used for some time in lighting the House of Commons, that oil lamps thus fed with vital air, were expensive and difficult to regulate.

Mr. Gurney then tried to illuminate the House with naphthalized coal gas, in argand burners, similarly supplied with oxygen; and though this produced a light of sufficient intensity, he encountered a formidable obstacle to its continuance from the deposition of liquid naphtha in the tubes of distribution. He next happily discovered a

method of obtaining, from ordinary coal gas, purified in a simple apparatus of his own, and burned with oxygen derived from the atmosphere, an effulgence adequate to every purpose of internal and external illumination, which is now used in the House of Commons with perfect success, and at a cost of only twelve shillings per night, whereas that of the candles previously used there amounted to six pounds eleven shillings per night.

This new Bude light possesses the following advantages over all other kinds of artificial illumination hitherto displayed.

First—it gives as much light as the best argand gas flames, with only one half the expenditure of gas. This very remarkable fact was established by experiments, carefully conducted, with the same standard wax candles which I employed for comparison prior to my examination before the late committee appointed to ascertain the best mode of lighting the House of Commons. A common argand gas flame was found to emit a light equal to ten such candles (three to a pound,) and a Bude burner, called No. 10, gave a light equal to 94.7 of the candles. Thus, the Bude flame had nearly ten times the illuminating power of the gas argand flame, while by means of an accurate gas metre, the former was ascertained to consume only 4.4 times the quantity of gas consumed by the latter, demonstrating the economy of the Bude light over common gas to be greater than two to one; and this economy increases in proportion to the magnitude of the light. The source of this surprising superiority may be observed by comparing the two flames: the base of the argand gas flame is of a blue tint for fourteen-sixteenths of an inch, a space in which the gas burns with intense heat, but little or no light; whereas the base of the Bude flame acquires a dazzling whiteness at three-sixteenths of an inch from the metal. Thus we see, that, through a range of eleven-sixteenths of an inch, the common argand gas flame is wasted in producing the nuisance of heat without light.

Secondly—from the phenomena just noticed, as also from the circumstance of the Bude flame emitting a double light with a single volume of gas, when compared with the gas argand, it is manifest that the former, in equal degree, can disengage at the utmost only one-half the heat that the latter does.

Thirdly—the Bude light simplifies greatly the means of artificial illumination, since it concentrates in one flame as much light as will diffuse, throughout a large apartment, a mid-day lustre, which may be softened by shades of every hue, and reflected by mirrors in every direction.

Fourthly—from this property proceeds its value as a ventilator, since the single tube which carries off the burned gases serves to draw out, also, the effluvia from a crowded chamber.

From all these facts, I am of opinion that Mr. Gurney's new Bude light is a most meritorious invention in reference to both public and private buildings, as it removes altogether the objections hitherto justly urged against the use of the highly hydrogenous gas of the London companies in dwelling houses—namely, that its heat is great in

proportion to its light, when compared with the more highly carburetted gases of Edinburgh and Glasgow.

The time must, therefore, be now at hand when the great economy and convenience of lighting private houses with gas will be experienced by the inhabitants of the metropolis, as they have been for such a considerable time by those of every town of importance in Scotland.

That the same quantity of coal gas may be made to produce a double amount of illumination in Mr. Gurney's patent burner to that obtained from it in an ordinary argand, will appear to many a paradoxical, if not a doubtful, proposition. Of its reality, however, I am fully convinced, and I think the fact may be accounted for in the following way:

Light, in general, is proportional to the intensity of ignition, a truth well exemplified in the effect of the oxy-hydrogen flame upon a bit of lime or clay. On the same principle, when the flames of two candles are brought into close contact, they afford a compound light considerably greater than the sum of their separate lights. Now, Mr. Gurney's burner gives such a compound flame. It consists of two or more concentric cylinders of flame, mutually enhancing each other's temperature, just as in Fresnel's polycycle oil argand lamps, used in the French lighthouses.

In addition to the augmented intensity of ignition, we must also take into account the peculiar nature of the combustion of carburetted hydrogen gas, whether as generated from coal in a retort, or from oil in a lamp. The vivid whiteness of its flame is due to the separation in solid particles, and subsequent ignition, of its carbon. Pure hydrogen, when burned, affords a very feeble light; and whenever so much air is mixed with coal gas as is sufficient to consume all its carbon simultaneously with its hydrogen, it burns with a dim blue flame.

Now, in the base of a common argand flame, an excess of cold atmospheric oxygen is allowed to act upon the coal gas in the vacant spaces between the pin-holes, whereby the temperature being greatly lowered, while the carbon is consumed in the gaseous state, the light from these two causes is nearly null. It is not till the gaseous mixture rises and forms a continuous hot cylinder, without interstitial streams of air, that it emits a white light from the ignited particles of the carbon precipitated in the interior of the flame.

In Mr. Gurney's concentric series, the prejudicial excess of atmospheric air is prevented, and only so much permitted to come into contact with the gas as will effect the due separation and ignition of its carbon, even at the origin of the flame.

To these two causes conjoined—viz., the increased intensity of ignition, and the limited supply of oxygen—it is that the new *Bude* flame owes its economy of illumination. The effect of oxygen in excess is elegantly demonstrated by throwing up a stream of it within a gas argand flame, for the light is thus nearly annihilated, while the heat is prodigiously augmented.

As regards the specification of the patent for this improved mode

of lighting, which I have carefully examined, I have no hesitation in declaring it, in my opinion, to be valid and unimpeachable.

Lond. Jour. of Arts, Sci., & Manufac.

Notice of Experiments regarding the Visibility of Lights in Rapid Motion, made with a view to the Improvement of Lighthouses; and of some peculiarities in the impressions made by them on the Eye. By ALAN STEVENSON, *LL. B., F. R. S. E., Civil Engineer.*

In experimenting on this subject, I used the apparatus formerly employed by Captain Hall. It consisted of an octagonal frame, which carried eight of the disks that compose the central part of Fresnel's compound lens, and was susceptible of being revolved slowly or quickly, at pleasure, by means of a crank handle and some intermediate gearing. The experiments were nearly identical with those made by Captain Hall, who contrasted the effect of a single lens at rest, or moving very slowly, with that produced by the eight lenses, revolving with such velocity as to cause an apparently continuous impression on the eye. To this experiment I added that of comparing the beam thrown out by the central portion of a cylindric refractor, such as is used at the fixed light of the Isle of May, with the continuous impression obtained by the rapid revolution of the lenses. Captain Hall made all his comparisons at the short distance of one hundred yards, and in order to obtain some measure of the intensity, he viewed the lights through plates of colored glass until the luminous disks became invisible to the eye. I repeated these experiments at Gullan, under similar circumstances, but with very different results. I shall not, however, enter upon the discussion of these differences at present, although they are susceptible of explanation, and are corroborative of the conclusions at which I have arrived, by comparing the lights at a distance of fourteen miles, but shall proceed to detail the more important results which were obtained by the distant view. Several members of the Royal Society witnessed the results of the experiments, which I shall briefly describe in the following order:

1. The flash of the lens revolving slowly was very much larger than that of the rapidly revolving series; and this decreasing of size in the luminous object presented to the eye, became more marked as the rate of revolution was accelerated, so that at the velocity of eight or ten flashes in a second, the naked eye could hardly detect it, and only a few of the observers saw it; while the steady light from the refractor was distinctly visible.

2. There was also a marked falling off in the brilliancy of the rapid flashes as compared with that of the slow ones; but this effect was by no means so striking as the decrease of volume.

3. Continuity of impression was not attained at the rate of five flashes in a second, but each flash appeared to be distinctly separated by an interval of darkness; and even when the nearest approach to

continuity was made, by the recurrence of eight or ten flashes in a second, the light still presented a twinkling appearance, which was well contrasted with the steady and unchanging effect of the cylindric refractor.

4. The light of the cylindric refractor was, as already stated, steady and unchanging, and of much larger volume than the rapidly revolving flashes. It did not, however, appear so brilliant as the flashes of the quickly revolving lenses, more especially at the lower rate of five flashes in a second.

5. When viewed through a telescope, the difference of volume between the light of the cylindric refractor and that produced by the lenses at their greatest velocity, was very striking. The former presented a large diffuse object of inferior brilliancy, while the latter exhibited a sharp pin point of brilliant light.

Upon a careful consideration of these facts, it appears warrantable to draw the following general conclusions:

1. That our expectations as to the effects of light, when distributed according to the law of its natural horizontal divergence, are supported by observed facts as to the visibility of such lights, contrasted with those whose continuity of effect is produced by collecting the whole light into bright pencils, and causing them to revolve with great velocity.

2. It appears that this deficiency of visibility seems to be chiefly due to a want of volume in the luminous object, and also, although in a less degree, to a loss of intensity; both of which defects appear to increase in proportion as the motion of the luminous object is accelerated.

3. That this deficiency of volume is the most remarkable optical phenomenon connected with the rapid motion of luminous bodies, and that it appears to be directly proportional to the velocity of their passage over the eye.

4. That there is reason to suspect that the visibility of distant lights depends on the volume of the impression, in a greater degree than has, perhaps, been generally imagined.

5. That as the size and intensity of the radiants causing these various impressions to a distant observer, are the same, the volume of the light, and, consequently, *cæteris paribus*, its visibility is, within certain limits, proportionate to the time during which the object is present to the eye.

Such appear to be the general conclusions which these experiments warrant us in drawing; and the practical result, in so far as lighthouses are concerned, seems sufficient to discourage us from attempting to improve the visibility of fixed lights in the manner proposed by Captain Hall, even supposing the practical difficulties connected with the great centrifugal force generated by the rapid revolution of the lenses, to be less than they really are.

I shall be excused, I hope, for saying a few words in conclusion regarding the decrease in the volume of the luminous object, caused by the rapid motion of the lights. This effect is interesting, from the apparent connexion with the curious phenomenon of irradiation. When

minous bodies, such as the lights of distant lamps, are seen by night, ey appear much larger than they would do by day; and this effect i said to be produced by irradiation. M. Plateau, in his elaborate say on this subject, after a careful examination of all the theories of radiation, states it to be his opinion that the most probable mode of ccounting for the various observed phenomena of irradiation, is to ppose that, in the case of a night view, the excitement caused by ght is propagated over the retina beyond the limits of the day image f the object, owing to the increased stimulus produced by the conast of light and darkness; and he also lays it down as a law, conrmed by numerous experiments, that irradiation increases with the uration of the observation. It appears, therefore, not unreasonable conjecture, that the deficiency of volume observed during the rapid evolution of the lenses, may have been caused by the light being resent to the eye so short a time, that the retina was not stimulated a degree sufficient to produce the amount of irradiation required r causing a large visual object. When, indeed, the statement of M. 'lateau, that irradiation is proportional to the duration of the obser'ation, is taken, in connexion with the observed fact that the volume f the light decreased as the motion of the lenses was accelerated, it eems almost impossible to avoid connecting together the two phenoiena, as cause and effect. Edinb. New Philos. Jour.

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upplement to a Report upon the Apparatus for Heating and Ventilating the Apartments in the Reform Club House. By ANDREW URE, *M. D., F. R. S.*

The cheering and bracing action of condensed air, and the opposite ffects of rarefied air, upon human beings, formed the subject of seeral fine physiological experiments made a few years ago, by M. unot, and described by him in the ninth volume of the *Archives Gerales de Médecine.* "When a person is placed," says he, "in conensed air, he breathes with a new facility; he feels as if the capacity f his lungs was enlarged; his respirations become deeper and less equent; he experiences, in the course of a short time, an agreeable ow in his chest, as if the pulmonary cells were becoming dilated ith an elastic spirit, while the whole frame receives, at each inspition, fresh vital impulsion. The functions of the brain get excited, e imagination becomes vivid, and the ideas flow with a delightful cility; digestion is rendered more active, as after gentle exercise in e air, because the secretory organs participate immediately in the creased energy of the arterial system, and there is, therefore, no irst."

In rarefied air the effects on the living functions are just the reverse. he breathing is difficult, feeble, frequent, and terminates in an asthiatic paroxysm; the pulse is quick and most compressible; hæmorrages often occur, with a tendency to fainting; the secretions are anty, or totally suppressed; and at length apathy supervenes.

These striking results, obtained on one individual at a time, with a

small experimental apparatus, have been recently re-produced, on a working scale, with many persons at once enclosed in a mining shaft, encased with strong tubing, formed of a series of large sheet iron cylinders, riveted together, and sunk to a great depth through the bed of the river Loire, near Languin. The seams of coal, in this district of France, lie under a stratum of quicksand, from eighteen to twenty metres thick, (twenty to twenty-two yards,) and they had been found to be inaccessible by all the ordinary modes of mining previously practised. The obstacle had been regarded to be so perfectly insurmountable, that every portion of the great coal basin that extends under these alluvial deposits, though well known for centuries, had remained untouched. To endeavor, by the usual workings, to penetrate through these semi-fluid quicksands, which communicate with the waters of the Loire, was, in fact, nothing less than to try to sink a shaft in that river, or to drain the river itself. But this difficulty has been successfully grappled with, through the resources of science, boldly applied by M. Triger, an able civil engineer.

By means of the above frame of iron tubing, furnished with an air-tight ante-chamber at its top, he has contrived to keep his workmen immersed in air, sufficiently condensed by forcing-pumps to repel the water from the bottom of the iron cylinders, and thereby to enable them to excavate the gravel and stones to a great depth. The compartment at top has a man-hole door in its cover, and another in its floor. The men, after being introduced into it, shut the door over their heads, and then turn the stop-cock upon a pipe in connexion with the condensed air in the under-shaft. An equilibrium of pressure is soon established in the ante-chamber, by the influx of the dense air from below, whereby the man-hole door in the floor may be readily opened, to allow the men to descend. Here they work in air, maintained at a pressure of three atmospheres, by the incessant action of leathern valved pumps, driven by a steam engine. While the dense air thus drives the waters of the quicksand communicating with the Loire out of the shaft, it infuses at the same time such energy into the miners, that they can easily excavate double the work without fatigue, which they could do in the open air. Upon many of them, the first sensations are painful, especially upon the ears and eyes; but ere long they get quite reconciled to the bracing element. Old asthmatic men become here effective operatives; deaf persons recover their hearing, while others are sensible to the slightest whisper. The latter phenomenon proceeds from the stronger pulses of the dense air upon the membrane of the drum of the ear.

Much annoyance was at first experienced from the rapid combustion of the candles, but this was obviated by the substitution of flax for cotton thread in the wicks. The temperature of the air is raised a few degrees by the condensation.

Men who descend to considerable depths in diving-bells, experience an augmentation of muscular energy, similar to that above described. They thereby acquire the power of bending over their knees strong bars of iron, which they would find quite inflexible, by their utmost efforts, when drawn up to the surface.

These curious facts clearly illustrate and strongly enforce the propriety of ventilating apartments by means of condensed air, and not by air rarefied with large chimney drafts, as has been hitherto most injudiciously, wastefully, and filthily done, in too many cases.

London, May 21st, 1842. Lond. Jour. of Arts.

Photography.

A very remarkable discovery, with respect to the self-transmitting property of figured surfaces, under certain circumstances, has been recently made by Dr. Moser, of Konigsberg, which would seem to indicate that there is something else than *light* concerned in the production of such effects, and that we must look for some fitter term than *Photo*-graphy to designate the branch of science or art to which they belong. The following is the account of this discovery, brought to this country by Professor Bessel, as communicated by him to the late meeting of the British Association, through the medium of Sir David Brewster, and published in the *Athenæum.*

A black plate of horn, or agate, is placed below a polished surface of silver, at the distance of one-twentieth of an inch, and remains there for ten minutes. The surface of the silver receives an impression of the figure, writing, or crest, which may be cut upon the agate or horn. The figures, &c., do not appear on the silver at the expiration of the ten minutes, but are rendered visible by exposing the silver plate to vapor, either of amber, water, mercury, or any other fluid.

Sir D. Brewster stated that he had heard Professor Bessel say, that the vapors of different fluids were analogous to the different colored rays of the spectrum; that the different fluids had different effects, corresponding to those of the spectrum; and that they could, in consequence of such correspondence, produce a red, blue, or violet color.

The image of the *camera obscura* might be projected on any surface—glass, silver, or the smooth leather cover of a book—without any previous preparation, and the effects would be the same as those produced on a silver plate covered with iodine.

This paper gave rise to an animated conversation, in the course of which M. Bessel said that he had seen some of the pictures taken by this process, which were nearly, but not quite, as good as those obtained by Mr. Talbot's process.

Sir D. Brewster said, this was the germ of one of the most extraordinary discoveries of modern days; by it there seemed to be some thermal effect which became fixed in the black substance; and not only so, but M. Bessel informed him that different lights seemed to affect different vapors variously, so that there seemed to be something like a power of rendering light latent—a circumstance which, if it turned out so, would open up very new and curious conceptions of the physical nature of light. On the emission theory, it would be easy to account for this; on the undulatory theory, he could not conceive how it could be possible.

Professor M'Cullagh said, he believed Newton had somewhere

thrown out a suggestion, that luminous particles, as they entered into bodies, might be caught and retained, within certain bounds, by continual attractions.

Sir D. Brewster said, that the experiments which he had performed with nitrous gas seemed to strengthen some such view as this, for, at certain temperatures, we had here an instance of a gaseous body as impervious to light as a piece of iron.

Sir J. Herschell thought it a pity to encumber this new and extensive field of discovery now laid open to them by any speculations connected with the theory, either of undulations or emissions. He had found that paper could be so prepared as that the impressions of some colors might became permanent upon it, while others were not; and thus it became possible to impress on it colored figures by the action of light. He exhibited a piece of paper so prepared, which at present had no form or picture impressed on it, but which was so prepared that, by holding it in strong light, a red picture would become developed on it.

Mech. Mag.

Dr. Payerne's Sub-Aqueous Experiments.

Dr. Payerne repeated on Wednesday last, at the Polytechnic Institution, (for the third time,) his experiment of living under water without communication with the upper air. He descended in the bell precisely at eleven o'clock, and remained there without any other supply of vital air than that which he was able to manufacture for himself (the *how* is the puzzling question) for three hours. The temperature of the Hall, at the time of Dr. P.'s descent, was 74° Fahr., and a thermometer which he took down with him, and examined every quarter of an hour, exhibited the following changes:

Hour.	Thermometer.	Hour.	Thermometer.
11	67	12¾	65
¼	68	1	65
½	67	¼	65
¾	66	½	65
12	65½	¾	65
¼	65	2	65
½	65		

Dr. Payerne states that the only inconvenience he felt was a slight stunning sensation on first descending in the bell, and on emerging from it, occasioned, no doubt, by the sudden transition from one degree of temperature and pressure to another.

Patents for the invention are now in the course of being applied for, and until they are secured, it is not to be expected that any public disclosure of the means made use of by Dr. Payerne will be made.

To demonstrate, in the meanwhile, the practical value of the invention, by a still severer proof than any to which it has yet been subjected, Dr. Payerne has made an offer to the Lords of the Admiralty, to go down *to any depth, in any place they may select, and to remain constantly submerged for the space of twenty-four hours.*

We think it probable their lordships may hesitate to be consenting parties to an experiment so certain, under any circumstances, to be of a very trying description—for nature must require the repose of sleep under water as well as above—and which, for anything yet known to the public, may be full of danger; but we may, at least, confidently reckon on their affording Dr. Payerne every facility and assistance within reasonable and prudent limits, for testing the working capabilities of his system. Ibid.

On the Calcination of the Chlorate of Potass.

At a late meeting of the Academy of Sciences, Paris, a communication was made relative to some experiments, by M. Milon, in the calcination of the chlorate of potass. Fifteen years ago, M. Serullas, professor of the Military Hospital of the Val-de-Grace, announced the discovery of the hypo-chlorate of potass, during the calcination of the chlorate. This unexpected fact excited, at the time, great interest among chemists, the calcination of the potass having long been an operation for the preparation of oxygen. The experiments of Serullas were, therefore, repeated, and were confirmed by all the chemists who performed them. The new formula of the decomposition of the chlorate, was regarded as explanatory of the march of the phenomenon. It appears, however, from the experiments of M. Milon, that something more was to be learned. He has ascertained that the hypo-chlorate of potass is not immediately transformed into the chlorute of potassium and oxygen, but into chlorite and chlorure. He was able to isolate the chlorite of potass, to produce the chlorites of lead and silver, and to prepare chlorous acid, of which he gives the following account: The chlorous acid, formed of one equivalent of chlorine and three of oxygen, corresponding as to its composition and properties with nitrous acid, is, under most circumstances, the most stable of all the compounds which chlorine forms with oxygen. M. Milon describes various means of obtaining it in the greatest state of purity. The most simple and elegant of these consists in treating arsenious acid with nitric acid, perfectly pure, and with the chlorate of potass, chlorous acid is produced with great facility. It is a more highly-colored gas than chlorine, but differing from it in most of its properties. It does not—which is a surprising fact—attack even finely pulverised arsenic, or the other metals which combine so powerfully with chlorine. Exposed to the action of the solar light, it is decomposed, and produces per chloric acid. In this experiment, the solar light acts both as heat and light. Heat alone, however, is capable of producing this result, but light without heat will not. The chlorous acid is slightly soluble in water, to which it communicates a yellow color, with an intensity which may be compared to that of the chlorate of potass. In solution it gives out a vapor, which is at first invisible, but becomes gradually visible, and at length assumes the appearance of a dense fog. A few drops of liquid, thrown into a jar filled with ten litres of damp air, suffice to render it perfectly opaque.

This phenomenon has particularly attracted the attention of M. Arago, who is of opinion that an opaque atmosphere may be produced at will, and thereby lead to the solution of most important problems on the polarization of light, whioh have hitherto not been resolved for want of the means of observation. The discovery of the chlorous acid is a fact of high importance. It completes the series of the combination of the chlorine and oxygen, and establishes an analogy the more between these compounds and the corresponding compounds of azote.

Mining Jour.

Improved Modification of a New Electrotype Process. By M. Newsam.

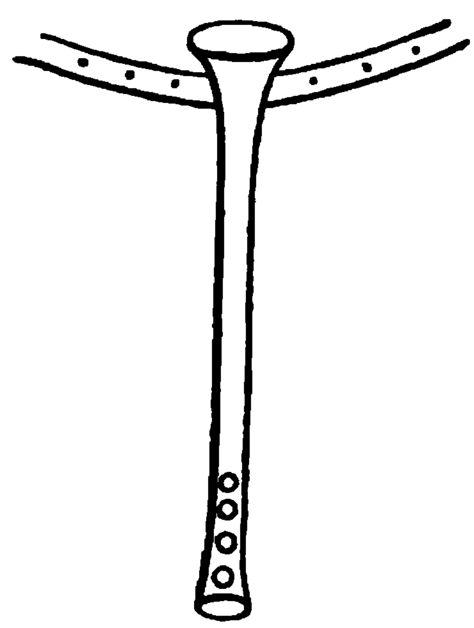
A discovery has been recently made of etching copper plates, by first gilding them by the electrotype, and then delineating the drawing through the coat of gold to the copper. I tried the gilding process several times, but could not succeed in producing a firm coat of metal; and I am acquainted with many scientific gentlemen who arrived at the same result—namely, a dirty black powder, easily rubbed off, instead of the *"glittering metallic surface of incomparable beauty,"* as it has been designated by some. Indeed I am half inclined to doubt that such a thing has ever been accomplished. My trials with the "noble" metals proving in every case a decided failure, I thought of trying what could be done by means of the cupreous deposit, as I always found it perfectly pure and firm, provided, only, care were taken in conducting the process. My first experiment proved quite successful; the subject of it was an ordinary steel plate. I covered it with a thin film of copper, which I afterwards etched, and bit up with dilute sulphuric acid. Far finer and closer lines can be formed on this ground than on that in general use at present, which arises from the latter being required to be laid comparatively thicker on, which together with its property of adhering to the point of the tool, during the process, sometimes sends a whole body of fine line-work into a broken unmeaning mass. What I consider the greatest advantage attending working on a metallic "ground," is, that after the effect, &c., is bit in, the plate can again undergo the same process, if the resulting etching be not satisfactory—an object not to be attained by the employment of grounds of a waxy or resinous nature. Such grounds always require to be totally removed before the picture can be pronounced perfect—at least as regards the etching; and if the same be found, on inspection, to be not of the requisite degree of color, or depth of tone, the touching up is attended with labor and uncertainty. A plate furnished with a metallic ground, can, however, be bit deeper, even *after* a proof has been printed from it, the coat of metal, of course, being allowed to remain on the plate.

Mech. Mag.

Remedy for Spontaneous Combustion of Coals.

Captain Carpenter, of Her Majesty's steam frigate *Geyser*, has suggested the following remedy for spontaneous combustion.

It is proposed to have several cast iron tubes, with holes at the lower part, as shown in the following figure, passing into the bunker, or coal-hole, nearly to the bottom of the vessel, and only a few inches from the ship's side, properly secured. The upper parts of these tubes are to come up to the deck, and to be contrived so as to give ventilation without allowing wet to go down amongst the coals. At the same time, means are to be afforded of pouring water into the bunkers, so as to flood them at the bottom in case of ignition. The water, in that case, would have a two-fold effect, as it would not only extinguish the fire at the place where danger is to be apprehended, but at the same time, the water poured into the tubes would destroy all ventilation, and have a tendency to smother the part ignited.



The cause of spontaneous combustion is, evidently, first, the accumulation of gases from the moisture of the coals; and then either heat or friction gives rise to ignition. To obviate this evil, if you allow the atmospheric air to pass freely amongst the coals, of course the gases could not accumulate, and combustion would not take place. If, however, there should be parts where the air did not penetrate, then the remedy is effected by pouring water into the bottom of the coal-box, and extinguishing the fire. The smoke issuing from the tube on deck, would always give timely notice of danger; and the hose on deck, pointed into the upper part of the tube, would provide a sufficient supply of water always at hand. The tubes would be about six inches in diameter, and about a quarter of an inch thick; their length would be regulated by the depth of the coal-box.

Hay-stacks are provided with the same remedy against taking fire, by introducing a large basket tube down the centre; and why should not the same result take place in the manner proposed? Ibid.

METEOROLOGICAL OBSERVATIONS FOR JUNE, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
☽	1	52°	70°	29.90	29.96	W.	Moderate		Clear.	Clear.
	2	50	75	30.00	30.10	E.	do		Clear.	Clear.
	3	48	74	30.05	29.95	E. S.	do		Clear.	Clear.
	4	58	74	29.90	29.85	S.	do		Cloudy.	Cloudy.
	5	64	78	29.80	29.80	SW.	do		Cloudy.	Clear.
	6	64	73	29.75	29.80	W.	do		Cloudy.	Partially cloudy.
	7	48	67	30.10	30.15	E. SE.	do		Clear.	Clear.
⊗	8	48	69	30.25	30.25	SE.	do		Cloudy.	Cloudy.
	9	58	71	30.00	29.90	S.	do	.35	Rain.	Cloudy.
	10	63	75	29.70	29.70	W.	do	.20	Rain.	Clear.
	11	47	60	29.80	29.95	NW.	do		Clear.	Clear.
	12	40	70	30.10	30.10	W.	do		Clear.	Clear.
	13	52	76	30.00	29.95	S.	do		Lightly cl'dy	Lightly cloudy.
	14	62	70	29.90	30.00	E.	do		Clear.	Clear.
☾	15	64	71	29.96	29.96	E. SW.	do	.53	Rain.	Rain.
	16	66	78	29.83	29.83	SW.	do		Cloudy.	Cloudy.
	17	68	73	29.83	29.83	SW.	do	.05	Cloudy.	Rain.
	18	68	79	29.83	29.83	SE.	do	.17	Rain.	Flying clouds.
	19	69	79	29.70	29.70	SW.	do	.35	Cloudy.	Rain; cloudy.
	20	68	72	29.74	29.86	W.	do		Cloudy.	Cloudy.
	21	64	78	29.95	30.00	W.	do		Clear.	Clear.
☉	22	63	82	29.90	29.83	W.	do		Fog.	Cloudy.
	23	70	73	29.73	29.68	SE.	do	.08	Rain.	Cloudy.
	24	62	72	29.81	29.81	NE.	do		Cloudy.	Cloudy.
	25	62	67	29.84	29.84	W. S.	Brisk		Fog.	Cloudy.
	26	66	80	29.62	29.61	SW.	Moderate	.23	Rain.	Partially cloudy.
	27	68	74	29.58	29.90	E.	do	.14	Par. cloudy.	Rain.
	28	62	76	29.75	29.75	SW.	do		Cloudy.	Flying clouds.
	29	65	82	29.75	29.90	W.	do		Clear.	Clear.
☽	30	66	86	29.94	29.94	W.	do		Clear.	Clear.
		60.13	70.13	29.89	29.89			2.10		

Thermometer. Max. 86.00 on 30th, 27th & 31st. Min. 40.00 on 12th. } Mean, 67.13.

Barometer. Max. 30.25 on 8th. Min. 29.58 on 27th. } Mean 29.[illegible]

SEPTEMBER, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	64°	78°	30.10	30.10	S. SE.	Moderate		Cloudy.	Clear.
	2	64	80	30.00	30.00	W.	do		Clear.	Clear.
	3	69	82	29.95	29.90	SW.	Brisk		Cloudy.	Clear.
⊗	4	68	74	29.96	30.00	NE. SE.	Moderate	.45	Rain.	Cloudy.
	5	72	78	29.84	29.84	W.	do	.14	Rain.	Cloudy.
	6	62	74	29.96	30.00	NE. E.	do		Clear.	Clear.
	7	60	75	29.94	29.94	SW.	do		Cloudy.	Clear.
	8	64	77	29.90	29.90	SE.	do		Par. cloudy.	Partially cloudy.
	9	72	78	29.80	29.90	SW.	Brisk		Cloudy.	Cloudy.
	10	62	69	29.95	30.00	E.	Moderate		Cloudy.	Cloudy.
☾	11	62	75	30.00	29.90	SW.	do		Cloudy.	Lightly cloudy.
	12	72	85	29.73	29.73	W.	Brisk		Cloudy.	Clear.
	13	73	81	29.50	29.50	W.	do		Lightly cl'dy.	Lightly cloudy.
	14	63	65	29.85	29.84	NE.	Moderate	.45	Cloudy.	Rain.
	15	62	69	29.84	29.84	NE. E.	do		Cloudy.	Cloudy.
	16	60	67	29.84	29.86	E.	do		Cloudy.	Cloudy.
	17	54	69	29.90	29.90	W.	Brisk		Lightly cl'dy.	Clear.
	18	54	68	29.80	29.80	W. SW.	do		Lightly cl'dy.	Clear.
☉	19	56	66	29.80	29.80	NW.	do		Lightly cl'dy.	Lightly cloudy.
	20	48	62	30.00	30.00	W.	do		Clear.	Clear.
	21	48	65	29.85	29.70	W.	do		Lightly cl'dy.	Lightly cloudy.
	22	45	60	29.86	29.86	W.	Brisk		Clear.	Clear.
	23	40	57	30.00	30.00	W.	Moderate		Clear.	Clear.
	24	43	61	30.05	30.05	W.	do		Clear.	Clear.
	25	46	64	30.10	30.10	NW. E.	do		Lightly cl'dy.	Clear.
☽	26	47	67	30.13	30.14	W.	do		Clear.	Clear.
	27	49	70	30.14	30.10	W.	do		Clear.	Clear.
	28	52	74	29.93	29.85	W.	do		Lightly cl'dy.	Clear.
	29	56	72	29.90	29.95	N.	do		Clear.	Clear.
	30	56	65	29.96	29.90	E. W.	do		Cloudy.	Cloudy.
		58.10	70.87	29.92	29.92			1.04		

Thermometer. Maximum 85 on 12th. Minimum 40 on 23rd. } Mean 64.485

Barometer. Max. 30.14 on 26th. Min. 29.50 on 13th. } Mean 29.92

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